

A CLINICAL STUDY OF OUTCOME OF  
Nd:YAG LASER POSTERIOR CAPSULOTOMY  
FOR POSTERIOR CAPSULAR OPACIFICATION

DISSERTATION SUBMITTED FOR  
MASTER OF SURGERY DEGREE  
BRANCH III OPHTHALMOLOGY

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## **CERTIFICATE**

This is to certify that this dissertation entitled “**A CLINICAL STUDY OF OUT COME OF Nd: YAG LASER POSTERIOR CAPSULOTOMY FOR POSTERIOR CAPSULAR OPACIFICATION**” has been done by DR.C. SURIYA KUMAR guidance in Department of OPHTHALMOLOGY, Madurai Medical College, Madurai.

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## **DECLARATION**

I, Dr. C. SURIYA KUMAR solemnly declare that the dissertation titled “A CLINICAL STUDY OF OUT COME OF Nd: YAG LASER POSTERIOR CAPSULOTOMY FOR POSTERIOR CAPSULAR OPACIFICATION” been prepared by me.

This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the requirement for the award of M.S., (Ophthalmology) Branch-III degree Examination to be held in APRIL 2012.

**Place :** Madurai

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**Date :**

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## *PART - I*

# INTRODUCTION

# **ABSTRACT**

## **Purpose of The Study:**

To study the visual outcome in posterior capsular opacification treated with Nd : YAG Laser Posterior capsulotomy.

To Analyse the complications following Nd : YAG Laser capsulotomy like increased IOP, IOL markings, Retinal detachment, etc.,

## **Materials and Methods:**

We selected patients with visual deterioration due to posterior capsular opacification in our department of totally hundred patients. Before the procedure, visual acuity, IOP and posterior segment were examined for all the patients. Nd:YAG Laser capsulotomy performed and rechecked the parameters immediately after the procedure and after one hour, one day, one week, one month and three months.



## **Results**

Visual acuity improved in 96% of our patients , 4% showed no improvement, which was related to previous retinal problems and thick posterior capsule

Transient elevation of IOP above 21mm Hg was noted in 2 patients within 24 hours. Post laser Uveitis was observed in 1 patients which was controlled with steroid eye drops within one week.

## **Conclusion**

The Nd : YAG Laser is a non invasive surgical tool that provides excellent posterior capsulotomies with minimal complications. From the above study, it's clear that Nd:YAG Laser posterior capsulotomy is safe and effective procedure for creating capsular opening compared to invasive surgical procedures. The post operative results are very good and the complication rate is very low.

## **KEYWORDS**

- Nd: YAG Laser
- Posterior capsular opacification
- Extracapsular cataract extraction
- Posterior capsulotomy
- Intra ocular pressure
- IOL markings
- Retinal detachment
- Macular edema
- Endophthalmitis.

## INTRODUCTION

Technological advances in the medical field changed so many things in the management of medical diseases . LASER is one of the major break through in treating medical problems. For the past four decades, LASER has been applied in the management and still extensive investigations are underway. As a less invasive therapeutic modality , the use of laser is Expanding in numerous conditions .

The field of ophthalmology was one of the first to put laser to broad use, with modern ophthalmic practice routinely using laser in the treatment of certain ophthalmic diseases.

Femto second YAG Lasers are the latest, but certainly not the last, lasers to be introduced into the eyes as a blade. The most common application has been in the use of posterior capsulotomies in aphakic or pseudophakic patients<sup>1,2</sup>. Increased use of extracapsular cataract extraction along with an increasing tendency to leave the posterior capsules initially intact at the end of surgery has resulted in an increased number of opaque posterior capsules at a later date<sup>1,16,17</sup>.

Although these numbers will vary depending upon the surgeon and technique utilized, it would probably be safe to estimate that these are at least 30% over a long period of time<sup>2</sup>. For opening the posterior capsular opacities , the non invasive characteristics of the Nd :YAG LASER provides an excellent treatment modality

## **AIM OF THE STUDY**

## **AIM OF THE STUDY**

- ❖ To study the efficacy of Nd:YAG laser capsulotomy in posterior capsular opacification by analyzing the visual outcome.
- ❖ To study the intraocular pressure changes and other complications following Nd:YAG laser capsulotomy.

## HISTORICAL CONSIDERATIONS

The recognition that the radiant energy of the sun could damage the human eye was the first step in the development of ocular phototherapy.

- Bonetus, an ophthalmologist in Geneva in the 17<sup>th</sup> century, first described the occurrence of scotoma after sungazing.
- Czemy (1867) & Deutschman (1882) focused sunlight on the retina of rabbits by means of concave mirror and convex lenses and produced hyperpigmented scars.
- Modern history of photocoagulation began with the work of Gerd Meyer Schwickerath, a young ophthalmologist at the University of Hamburg, who demonstrated that focused radiant energy could be used to create chorioretinal lesions of clinical value.

He developed a photocoagulator, using the Sun as its light source.

It consisted of a Galilean telescope with a mirror that had a

Central aperture and was suspended on an universal joint in front of the ocular. He then employed as improved carbon arc and finally xenon-arc lamp.

## **Development of Laser**

- Theodore Maiman built the first laser, which employed ruby crystal as medium, in July 1960.
- In 1961, Zaret employed a ruby laser for iris, retinal photocoagulation in rabbits.
- The ruby laser was quickly supplemented with introduction of Argon laser photocoagulator. Earliest work in the development of Argon laser was done by L'Esperance and followed by studies of Zweng, Little, Patz and others.

## **Laser Effects on Tissues**

- Photo disruption
- Photo ablation
- Photo coagulation

## **Development of Photodisruption**

- It can be defined as the use of high peak power ionizing laser pulse to disrupt tissue. Light energy is concentrated in time and space to create optical breakdown and ionization of target medium with formation of plasma, which is seen as a spark.



- Krasnov–First to demonstrate that high peak power pulses could be used to produce clinically desirable disruption of ocular structures. He used ‘Q-switched’ ruby laser to treat trabecular meshwork of open angle glaucoma and called it as laser goniotomy. He also successfully ruptured the anterior capsule in rabbit eyes.
- Frankhauser and his associates Vander Zypen, Babie and Loertscher worked first with a Q-switched neodymium glass and subsequently with Q-switched Nd:YAG lasers. They coupled high-energy delivery system and used this device for cutting a variety of intraocular membranes<sup>2</sup>.
- Aron Rosa recognized the utility of Nd:YAG laser photodisruption for posterior capsulotomy in Oct 1978.

# LASER FUNDAMENTALS

## **Properties of Laser light**

***Monochromaticity:*** Lasers emit light at only one wavelength or at combination of several wavelengths that can be separated easily. Thus a pure or monochromatic beam is obtained. It can be used to enhance absorption by a target tissue and another useful property is that chromatic aberration in lens system can not occur.

***Directionality:*** Lasers emit a narrow beam that spreads very slowly. Lasers amplify only those photons that travel along a very narrow path between two mirrors. Beam divergence is the physical measurement of directionality of the light beam. It is expressed in milliradians (mrad). A typical laser has a beam divergence of 1 mrad – it means that the beam increases by about 1mm in diameter for every meter traveled. Directionality makes it easy to collect all of the light energy in a simple lens system and to focus this light to a small spot.

***Coherence:*** Extent to which the electromagnetic field of light wave varies regularly and predictably in time and space. Laser light projected on to the rough surface has a characteristic sparkling quality known as “laser speckle”.

***Polarisation:*** It is incorporated in the laser system to allow maximum transmission through laser medium without loss caused by reflection.

***Brightness and intensity:*** Radiometry is measurements of electromagnetic radiation. Radiant energy is measured in joule (j) and radiant power is measured in watt (w).

Intensity is the power in a beam of given angular size and brightness is the intensity per unit area. The laser output is quantitated in either Joules or Watts.

## **Laser Sources**

Solid – State laser sources: Ruby , Nd:YAG & Diode

Gas – laser sources : Argon, Krypton, carbondioxide & Eximer laser(Helium & Flourine gas)

# MECHANISM OF LASERS

## **Optical Breakdown, plasma formation and photodisruption**

Optical breakdown is a nonlinear effect achieved when laser light is sufficiently condensed in time and space to achieve high irradiance or density of power. Optical breakdown is a sudden event that is visibly manifested by a spark and accompanied by an audible snap with dramatic damage to the target. It produces an ionized state called as plasma. Light energy can create plasma when high irradiance is achieved, commonly between  $10^{10}$  and  $10^{12}$  watts/cm<sup>2</sup>.

### ***Ionization:***

2 different mechanism for optical breakdown by ‘Q- switched’ and ‘Mode locked’ Nd:YAG laser<sup>1</sup>.

‘Q – switched’ pulses cause ionization mainly by focal heating of target termed as thermionic emission. ‘Mode-locked’ pulses by multiphoton ionization.

### ***Growth:***

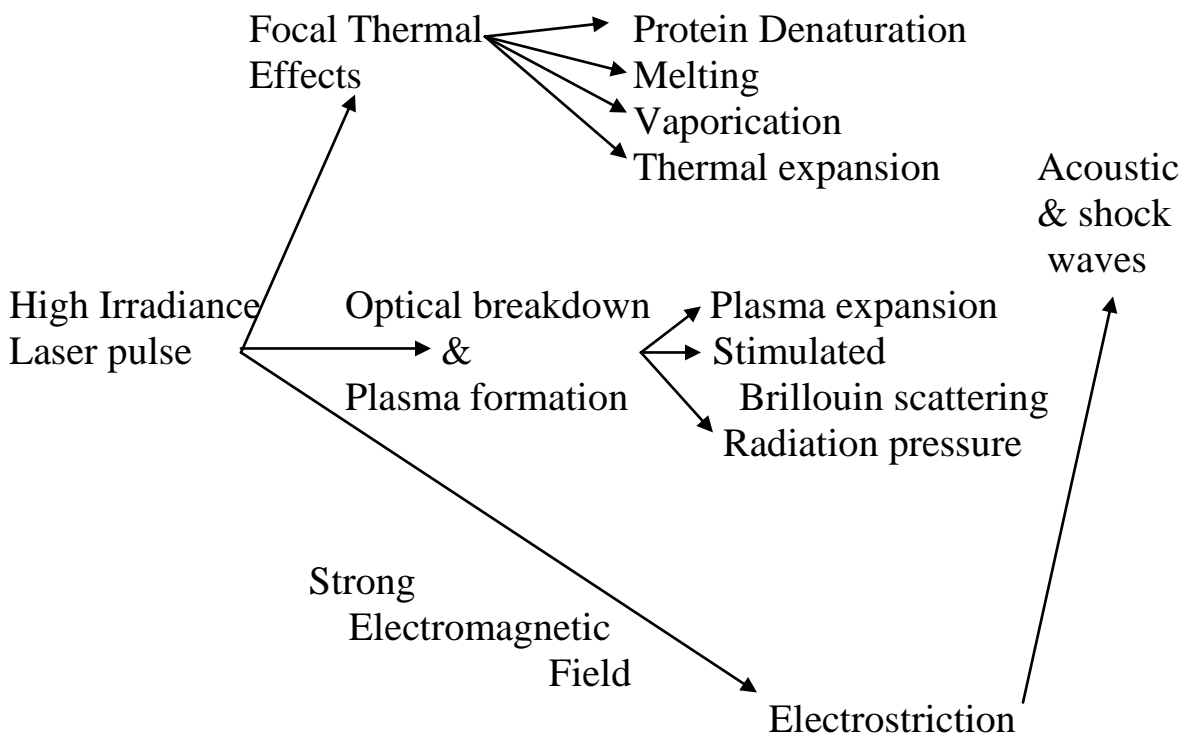
A free electron absorbs a photon and accelerates. The accelerated electron strikes another atom and ionizes it resulting in two free electrons each with less individual energy. These two free electrons absorb more photons, accelerate, strike other atoms and release two more electrons and so forth. The process of photon absorption and electron acceleration in the presence of atom or ion is technically known as inverse ‘bremsstrahlung’

### ***Plasma shielding:***

Once formed, plasma absorbs and scatters incident light. This property shields underlying structures that are in the beam path. In addition to absorption, plasma scatters light by a process known as Brillouin scattering and stimulated Brillouin scattering. In “Stimulated

Brillouin”, the light is scattered by thermally excited waves and shifted in a frequency equal to the frequency of photons characteristic of the material. In stimulated Brillouin scattering, which occurs at higher irradiance, the laser itself creates the acoustic wave that scatters it.

### **Mechanism of damage:**



### ***Thermal mechanism:***

The microplasma temperature reaches 15,000°C locally. Vaporization and melting of liquids and solids occur in a small volume near the focal

point. In biological systems, thermal denaturation of protein and nucleic acids is calculated to be confined to a radius of 0.1 mm for a 1 mj pulse.

***Pressure waves:***

Several mechanisms may combine to generate pressure waves radiating from the zone of optical breakdown. Among these, the rapid plasma expansion begins as a hypersonic shock wave. A second weaker source of hypersonic and sonic waves is stimulated Brillouin scattering, in which the laser light generates the pressure wave that scatters it. The focal heating can lead to phase change (vaporization and melting) and thermal expansion both of which generates acoustic waves. The electric field of laser light, if sufficiently strong will deform a target through electrostriction (mechanism that leads to simple Brillouin scattering) and through radiation pressure caused by momentum transfer from photons to atoms during inverse bremsstrahlung.

The shock wave is followed by cavitation or vapor bubble formation. Cavitation begins within 50 o 150nsec after breakdown in water. It

expands rapidly for the first  $20\mu\text{s}$  and reaches a maximum size of about 0.6 mm at  $300\mu\text{s}$ . Finally it collapses within 300 to  $650\mu\text{s}$ . Cavity propagation velocity is approximately 20m/sec at point  $300\mu$  from the breakdown. Cavitation is too rapid to be visible and should be distinguished from bubble formation. Persistent bubbles probably consist of hydrogen and oxygen gas.

***Spark Emission:***

The visible spark represents the release of energy as photons, when electrons recombine with ions (bremsstrahlung). The emission has a blackbody-like spectrum including the visible ultraviolet and in some materials the near x-ray wave lengths. The spark is a useful marker of the zone of optical breakdown.



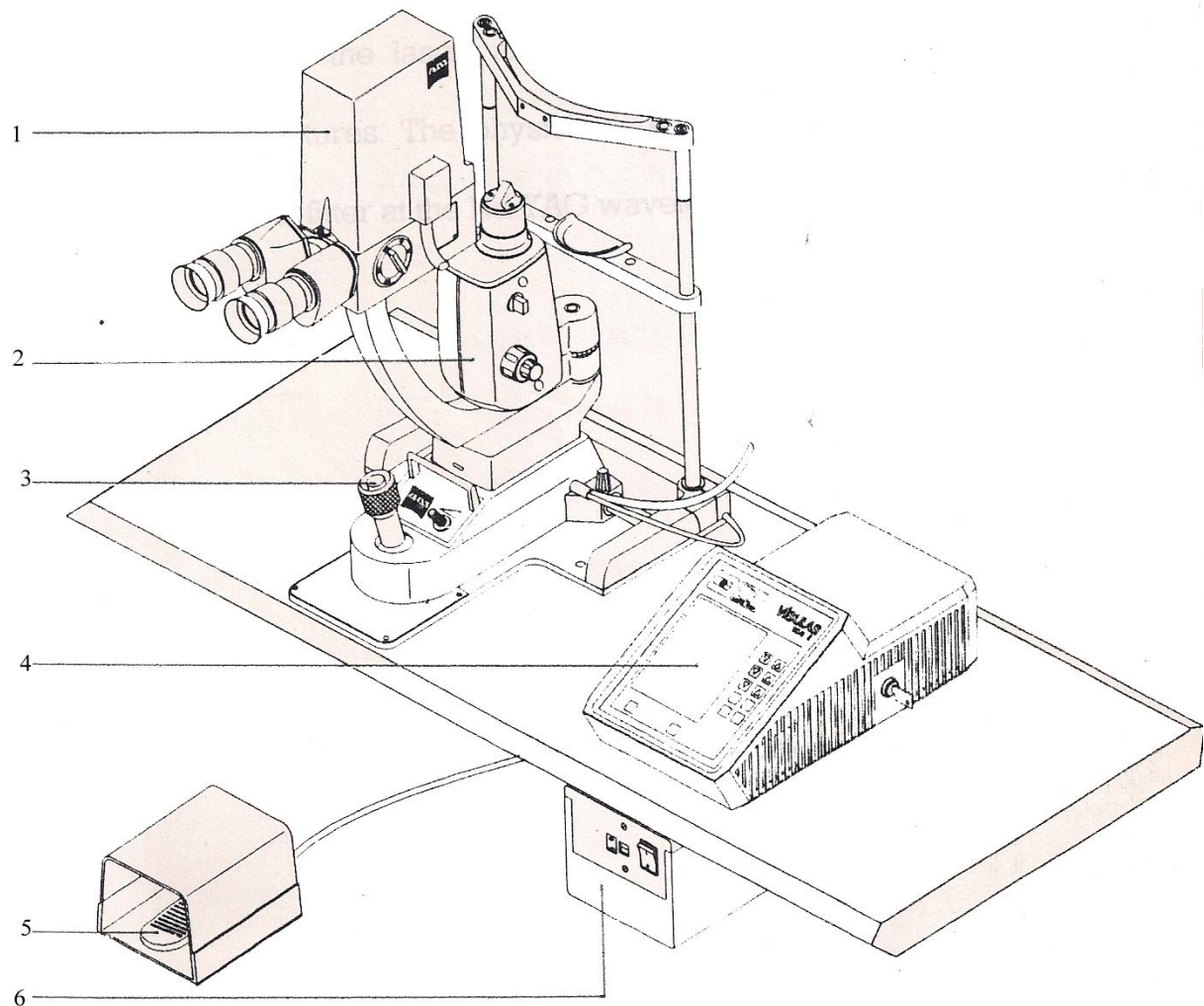
## Nd:YAG LASER-SYSTEM CONFIGURATION

The design of ophthalmic laser system for posterior capsulotomies begins with the choice of laser source. Following Table shows key laser parameters for both ‘Q-switched’ and ‘Mode locked’ Nd:YAG laser and compares them with an Argon photocoagulator.

Laser Parameters	Argon Photocoagulator	Nd:YAG Q-switched	Nd:YAG Mode locked
Wave length (mm)	488 – 545	1064	1064
Energy dose (mj)	50 – 500	4 – 15	3 – 6
Pulse duration (sec)	0.01 – 1.0	10-8	10-11
Peak power (W)	2	106	108
No. of Shots	1 – 100	1 – 20	1 – 50
Spot size on target (mm)	0.1 – 1	0.05	0.05

Difference between ‘Q-switched’ and ‘Mode locked’ lasers is in the method pulsing the laser. ‘Q-switched’ units use an electronic shutter called as pockel’s cells and generate a pulse of 10-20 nanosecond width. ‘Mode-locked’ units use a passive dye cell. Since the dye cells age and ultimately become ineffective, the dye in a mode locked

Nd:YAG system must be changed periodically.



- |                                      |  |
|--------------------------------------|--|
| 1. VISULAS YAG II laser head         | 4. Control unit                          |
| 2. Laser slit lamp                   | 5. Foot switch                           |
| 3. Joystick with hand release button | 6. Power supply unit for laser slit lamp |

## INSTRUMENT COMPONENTS

- Nd:YAG laser
- He: Ne guide laser
- Beam expanding optics
- Slit Lamp for delivery of beam
- Mechanism for delivering the beam from the lasers to moving slit lamp
- Electronics including laser power supplies
- Long Laser energy monitoring devices
- Safety interlock
- Suitable housing

Upon power up, all interlocks are activated and shutters closed. The Nd:YAG lasers may be fired (with the shutter closed) to verify the output power setting and He: Ne shutter maybe opened to allow visualization of the aim point of Nd:YAG beam. The Nd:YAG shutter may be opened and the Nd:YAG laser may be fired. The Nd:YAG beam is directed by mirrors to the slit lamp assembly where it is expanded using a Galilean telescope to obtain a diameter sufficient to create a low f-number and corresponding small spot size inside the patient's eye. The He: Ne beam travels in co-axial Path and can be used to locate aim point of Nd:YAG laser visually. The slit lamp is operated normally. Some systems provide independent adjustment of slit lamp illumination source from the laser, allowing improved visualization of ocular structures. The physician's eyes are protected by a band-reject filter at the Nd-YAG wavelength of 1064nm.

## Nd : YAG LASER INSTRUMENT



# POSTERIOR CAPSULAR OPACIFICATION

Postoperative opacification of initially clear posterior capsules occurs frequently in patients after extra capsular cataract extraction.

In adults, the time from surgery to visually significant opacification varies from months to years and the rate of opacification declines with increasing age. In younger age groups, almost 100% opacification occurs within 2 years after surgery<sup>9</sup>.

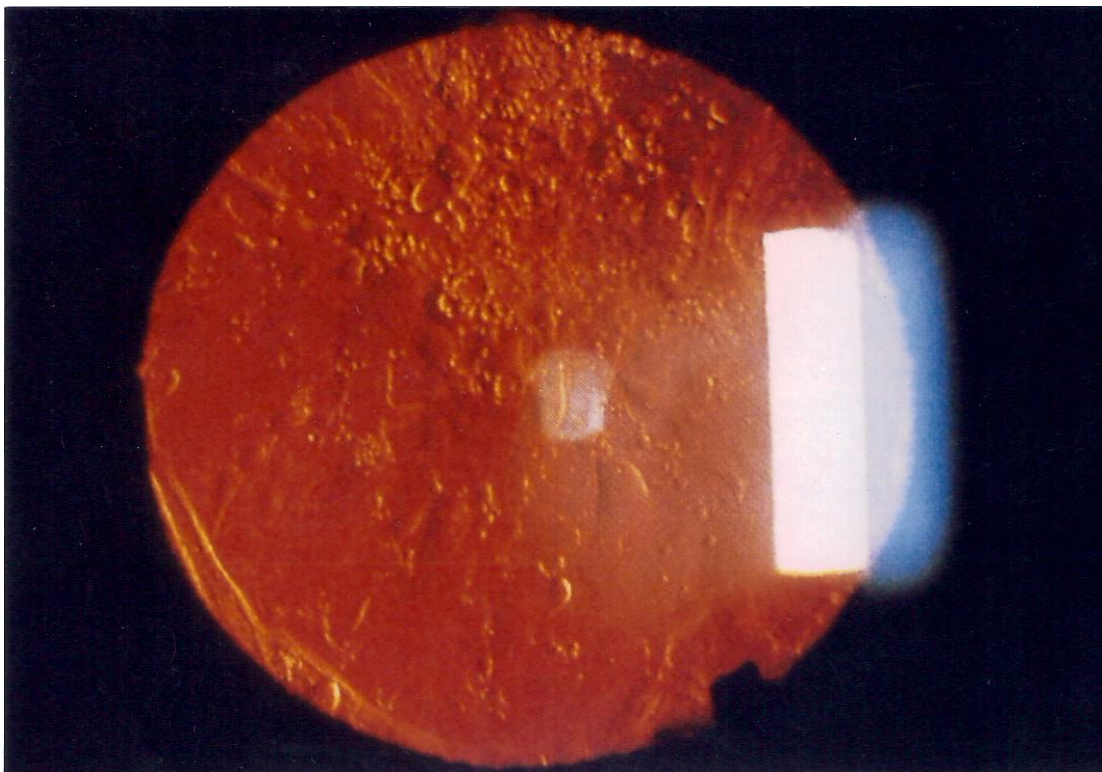
## ***Incidence:***

Varies with different studies.

Sinskey and Cain study- 43% in 26 months follow up.

Emery study – opacification in 28% with 2-3yrs follow up. Late opacification of posterior capsule after 3-5 years has been reported to be approximately 50%<sup>9</sup>.

## ELSCHNIG'S PEARLS



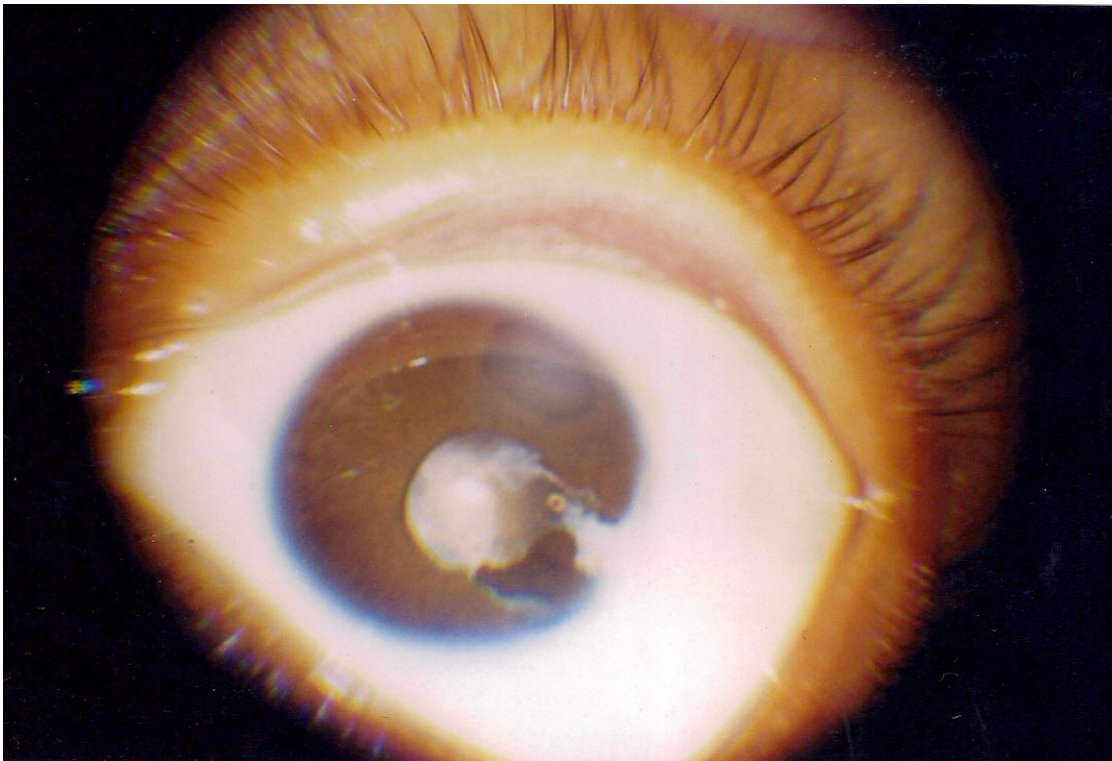
## **PHOTOLOGY OF CAPSULAR OPACIFICATION**

Posterior capsular opacification occurs as a result of formation of opaque secondary membranes by active lens epithelial proliferation, transformation of lens epithelial cells into fibroblasts with contractile elements and collagen deposition<sup>9,13</sup>. The anterior lens epithelial cells proliferate onto the posterior capsule at the site of apposition of anterior capsular flaps to the posterior capsule. The contraction caused by the myoblastic features of lens epithelial cells produces wrinkling of the posterior capsule. Collagen deposition results in white fibrotic opacities<sup>30</sup>.

Clinically, optical degradation of initially clear posterior capsule takes several forms. Fibrosis is one form characterised by the gray white band or plaque-like opacity<sup>9</sup>. It is usually seen in early postoperative period or may occur late. Fibrosis that is present in the first days to weeks postoperatively most often represents cortical lamellae left at the time of surgery. Fibrosis that develops months to years postoperatively is caused by migration of anterior lens epithelium, fibroblastic

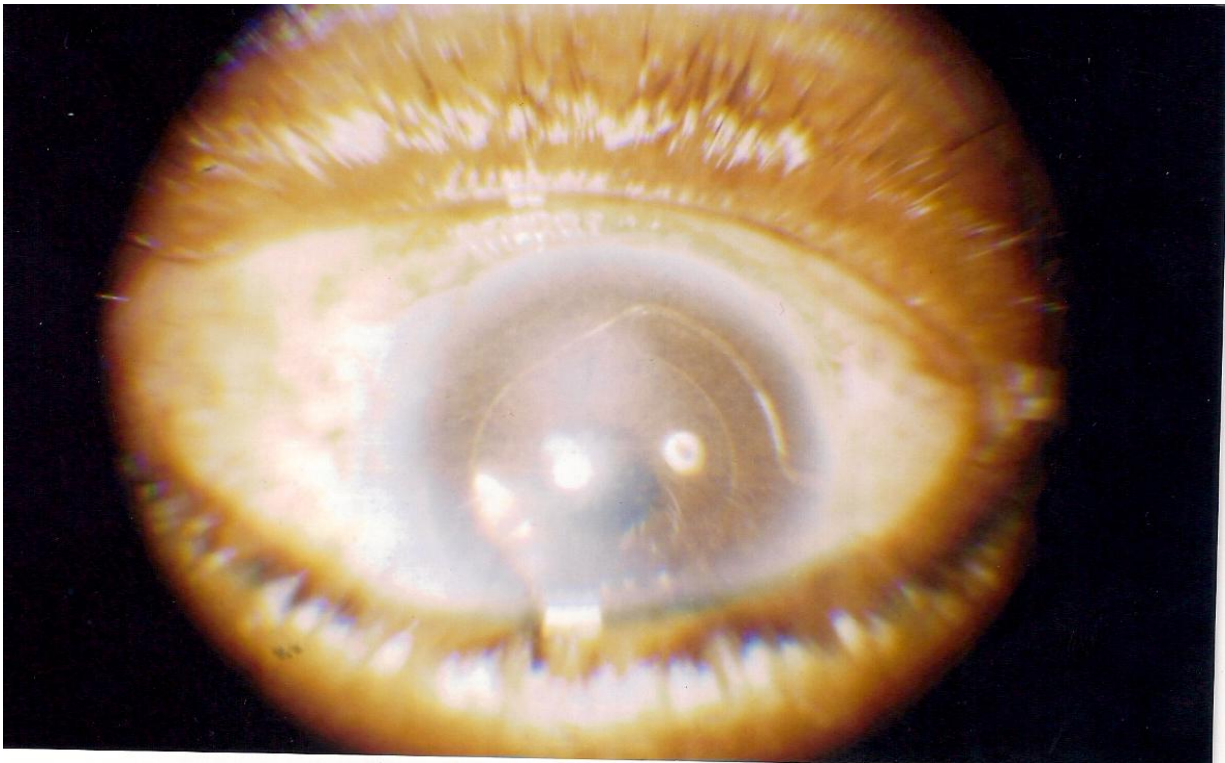


## APHAKIA WITH P.C.O.





**A.C. IOL WITH P.C.O.**



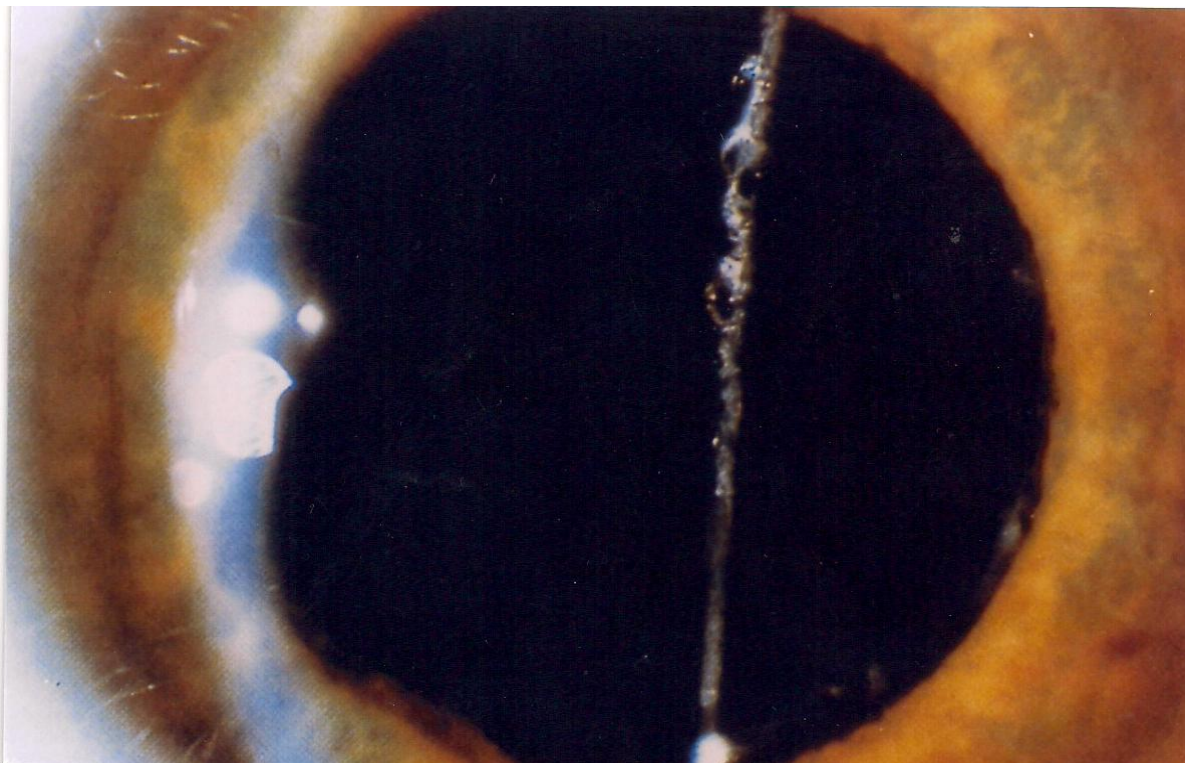
metaplasia and collagen production<sup>13</sup>. Formation of small Elschnig pearls and bladder cells, second major form of opacity, occurs months to years after surgery. This opacity occurs from proliferating lens epithelial cells, which can form layers, several cells thick.

Capsular wrinkling has two manifestations. Broad undulations of clear capsule are common in early postoperative period. Posterior chamber lens haptics may induce these broad wrinkles along the axis of haptic orientation. Fibrotic contraction can also lead to wrinkles. Broad undulating wrinkles of clear capsule are rarely disturbing to the patient<sup>9</sup>.

In contrast, fine wrinkles caused by myoblastic differentiation can result in marked optical disturbance. These fine wrinkles are caused by myofibroblastic differentiation of the migrating lens epithelial cells, which acquire contractile properties resulting in the wrinkles<sup>13</sup>.

If the iris forms synechiae to the capsule, reactive pigment epithelial hyperplasia and migration onto the capsule may occur. Most often these adhesions occur if large amount of cortex are left at time of surgery – common in traumatic cataract. Localised pigmented precipitates on the capsule and intraocular lens can occur spontaneously or after hemorrhage or inflammation.

## **CAPSULAR THICKENING THROUGH SLITBEAM**



## **Nd:YAG LASER POSTERIOR CAPSULOTOMY**

### ***INDICATIONS:***

Nd:YAG posterior capsulotomy is indicated for opacification of the posterior capsule resulting in decreased visual acuity for the patient. Careful assessment is necessary to be certain that posterior capsule opacification is the cause for decreased visual acuity<sup>29</sup>.

### ***CONTRAINDICATIONS:***

#### **Absolute Contraindications**

- Corneal scars, irregularities or edema that interferes with target visualization and makes optical breakdown unpredictable<sup>31</sup>.
- If the patient proves unable or unwilling to fixate adequately with the threat of inadvertent damage to adjacent intraocular structures.

### Relative Contraindications

- Glass intraocular lens because of possibility of causing complete fracture in the glass optic.
- Known or suspected Cystoid macular oedema.
- Active intraocular inflammation until the visual impairment becomes functionally unacceptable to the patient.
- High risk for retinal detachment<sup>33</sup>.

# TECHNIQUE

## **Preoperative Assessment**

All patients require complete ophthalmic history and examination before treatment. It includes

- Notation of medical History, topical and systemic medications.
- Vision
- Intraocular pressure of both eyes.
- Slit lamp examination.
- Fundus examination.

Judging the contribution of a capsular opacity to the patient's overall visual deficit may be difficult. Following techniques are useful for the assessment of capsular opacity.

- Direct ophthalmoscopic visualization of fundus structures since the visibility of retinal details correlates with patient's view of the world.
- Retinoscopy

- Red reflex evaluation by:
  - Slit lamp examination.
  - Direct ophthalmoscopic examination.
  - Indirect ophthalmoscopic examination.
- Laser Interferometer
- Potential acuity meter – helps to assess the macular function
- Fluorescein angiography – when capsular opacity seems inadequate to explain quality of vision, FFA has to be done to rule out Cystoid macular oedema.

## **Preparation of the patient**

The purpose and nature of the procedure should be explained to the patient and informed consent obtained beforehand. At the time of treatment, the patient is reassured by the familiar appearance of slit lamp delivery system. The surgeon should remind the patient that the procedure is painless. The patient may hear small clicks or pops, but the patient must simply maintain steady fixation. The procedure is completed in a matter of minutes<sup>2</sup>.

Apraclonidine or beta-blocking agent should be administered in the eye 1 hour prior to and immediately upon completion of Nd:YAG laser procedure to minimize a postoperative intraocular pressure spike.

Dilatation of pupil facilitates visualization of the capsule over a broad expanse. It is helpful for a surgeon inexperienced with laser capsulotomy. In the absence of miotic pupil, dilation may be omitted when an experienced surgeon is performing the procedure.

If the pupil is to be dilated, the landmarks of the pupillary zone of the capsule should be sketched. Inattention to the pupillary zone may result in an eccentric capsulotomy. The patient can be brought to the laser before dilatation and a single marker shot can be placed in the capsule near the middle of pupillary axis. For routine dilatation, a single drop of 2.5% phenylephrine or 0.5% tropicamide may be used.

No anaesthesia is generally required for capsulotomy unless contact lens is employed. If the contact lens is used, topical anaesthetic drops to be applied. The patient must be seated comfortably with properly adjusted stool, table, chin-rest heights and footrests. A Strap that passes from the



headrest behind the patient's head is useful to counteract the tendency of many patients to move back during the course of treatment. The surgeon's visualization of the target is usually improved in a darkened room. If the patient is expected to fixate with other eye, an illuminated fixation target should be provided.

## **PROCEDURE**

A contact lens such as the peymen or central Abraham lens may be used to stabilize the eye, improve the laser beam optics and facilitate accurate focussing. The Abraham lens increases the convergence angle to  $24^{\circ}$  from  $16^{\circ}$ , decreases the area of laser at the posterior capsule to  $14\mu\text{g}$  from  $21\mu\text{g}$  and increases the beam diameter at both the cornea and retina<sup>1</sup>.

Minimum amount of energy is desired to rupture the capsule.

With most lasers, a typical capsule can be opened by using 1 to 2 mj/pulse.

The capsule is examined for wrinkles that indicate tension lines. Shots placed across tension lines result in the largest opening per pulse.

## PERFORMING YAG LASER CAPSULOTOMY



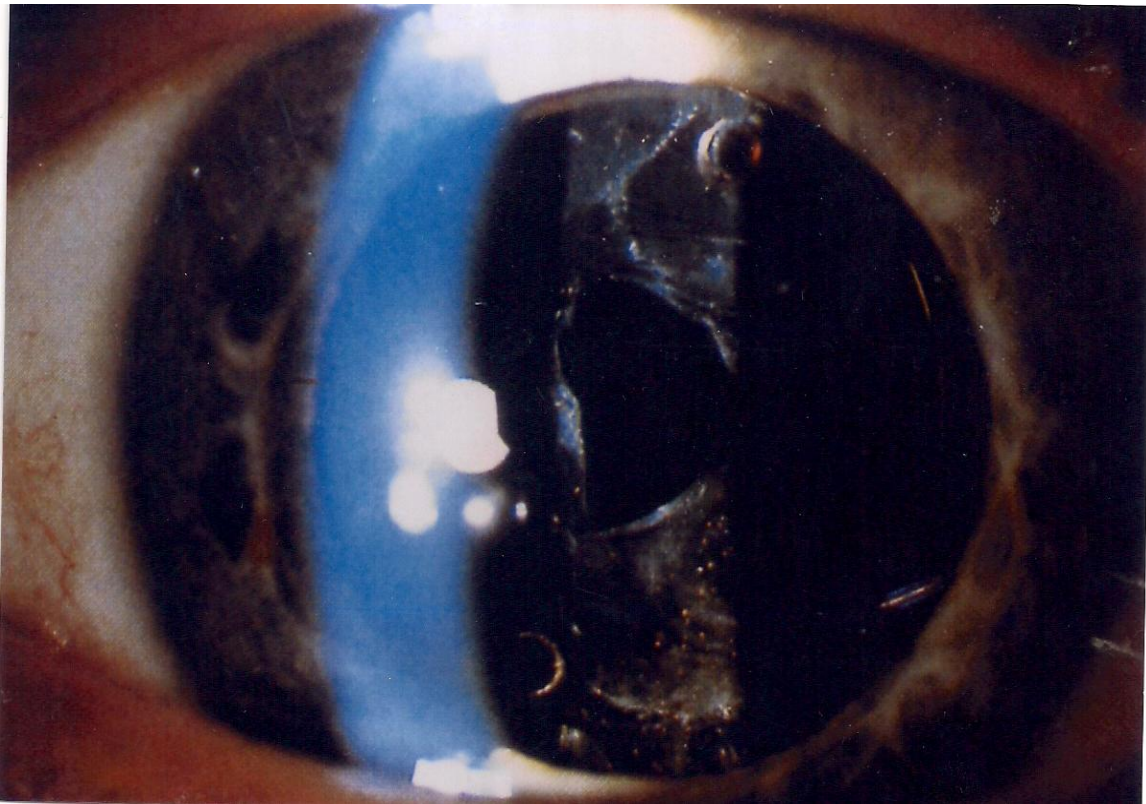
The usual strategy is to create a cruciate opening beginning superiorly near 12 o'clock position. Unless a wide opening has already developed, shots are then placed at the edge of capsule opening, progressing laterally towards 3 o'clock and 9 o'clock position. If any capsular flaps remain in the pupillary space, the laser is fired specifically at the flaps to cut them and cause them to retract and fall back to the periphery.

The goal is to achieve flaps based in the periphery inferiorly. Floating fragments should be avoided because they may remain and cause visual interference<sup>1</sup>.

Beginning the cruciate opening in the superior periphery has several advantages. The initial shots are in the periphery so that if the patient becomes startled and an adjacent intraocular lens is marked, the mark appears in the periphery. Both patient and surgeon can have settled down before more critical central area is treated. Furthermore, as the flap develops, gravity aids in pulling them towards the inferior periphery. In contrast, it can be very difficult to cause a flap hanging down from above to retract.

Following techniques are used to minimize intraocular lens marks

## AFTER LASER CAPSULOTOMY



- Use minimum energy
- Use a contact lens to stabilize the eye, improve the laser beam optics, and facilitate accurate focusing.
- Identify any areas of intraocular lens-capsule separation and begin treatment there.
- If lens marking is occurring, make an opening in the shape of a Christmas tree from 12 o'clock to the 4.30 o'clock position and from the 12 o'clock to the 7.30 o'clock position without planning any shots in the central optical zone.
- Use deep focus techniques: optical breakdown occurs in the anterior vitreous and the shock wave radiates forward and ruptures the capsule. High energy (2mj) must be used<sup>11</sup>.

***Capsulotomy size:***

The capsulotomy should be as large as the pupil in ambient light. A small opening in a dense membrane results in excellent optics. But when the capsule is only hazy and transmits image to the retina, that mixes with the image transmitted through clear, opening and the patient may experience symptoms of glare or decreased contrast sensitivity<sup>2,6</sup>.

A capsule with residual haze not only impairs vision under standard conditions but also produces glare. A clinical study by Steinert & Puliafito demonstrated that the glare and haze continue to be a problem for 1-2mm capsular opening, decrease with 3mm opening and fully resolve only with a 4mm capsular opening.

## **Post operative care**

After capsulotomy, apraclonidine or a betablocker should again be administered topically to minimize intraocular pressure rise<sup>9,20</sup>. For high-risk patients, intraocular pressure is measured again 1hour following laser treatment. If the patient has significant preexisting glaucomatous disc damage or intraocular pressure is increased by 5mm Hg or more at 1 hour, the intraocular pressure should also be remeasured at 4 hours.

An increased intraocular pressure may be treated with apraclonidine, betablocking drugs, topical pilocarpine, systemic carbonic anhydrase inhibitors and hyperosmotic agents<sup>21,22</sup>. If the intraocular pressure has increased following posterior capsulotomy, antiglaucoma therapy should be continued for atleast 1wk to prevent delayed pressure elevation. IOP should be again measured after 1 wk.

Treatment following laser therapy with topical steroids and cycloplegic agents varied widely according to the individual surgeon's experience. Since few patients experience iritis, some surgeons favour topical steroids 4 times daily for 1<sup>st</sup> postoperative week and then taper the steroid drops gradually.

## COMPLICATIONS

### **Intraocular pressure elevation:**

Most common complication following Nd:YAG laser capsulotomy – usually transient. The IOP typically begins to rise immediately following laser capsulotomy, peaks at 3 to 4 hours, decreases but may remain elevated at 24 hours and usually returns to baseline at 1 week. Rarely IOP may remain persistently elevated, causing visual field loss or requiring glaucoma surgery. The elevated IOP following Nd:YAG laser posterior capsulotomy has been associated with preexisting glaucoma, capsulotomy size, lack of posterior chamber intraocular lens, laser energy required for capsulotomy, myopia and preexisting vitreoretinal disease<sup>20,21,22</sup>.

Increased IOP following capsulotomy is associated with a reduced facility for aqueous humor outflow. This reduced facility has been attributed to capsular debris, acute inflammatory cells, and liquid vitreous and shock wave damage to the trabecular meshwork. Laboratory studies have demonstrated pigment granules, erythrocytes, fibrin, lymphocytes and macrophages within trabecular meshwork after



laser capsulotomy supporting the proposal that acute inflammatory cells and capsular debris are the cause of increased intraocular pressure. Eyes with preexisting glaucoma have an increased frequency and magnitude of intraocular pressure elevation following laser treatment because the glaucomatous eyes already have a reduced outflow facility and further obstruction of trabecular meshwork results in marked intraocular pressure increase<sup>21</sup>. Liquid vitreous as the cause of outflow obstruction has been supported by the clinical association between increased IOP following laser treatment and myopia, preexisting vitreoretinal disease, large capsulotomy, lack of posterior chamber intraocular lens and sulcus fixated posterior chamber intraocular lenses. A capsule fixated posterior chamber intraocular lens and a smaller capsulotomy may provide a barrier effect preventing liquid vitreous from reaching the anterior chamber and trabecular meshwork<sup>20,22</sup>. Nd:YAG induced shock wave causing increased intraocular pressure resulting in damage to the trabecular meshwork is supported clinically by the association between increased intraocular pressure and higher total laser energy used to create the capsulotomy<sup>21</sup>.

Since increased intraocular pressure is common complication following laser therapy and can result in permanent loss of vision, prevention of IOP rise is important. Apraclonidine, timolol, levobunolol, and pilocarpine have been shown to decrease the frequency and magnitude of IOP increase following laser treatment. These drugs are administered 1 hour prior to Nd:YAG laser posterior capsulotomy and again following the procedure. Patients at high risk for IOP elevation should be carefully monitored following laser capsulotomy<sup>22</sup>.

The IOP following laser capsulotomy may also be elevated by vitreous obstruction of sclerostomy, the development of neovascular glaucoma or pupillary block glaucoma<sup>20</sup>.

## **Cystoid macular oedema**

It has been reported to develop in 0.55-2.5% of eyes following Nd:YAG laser posterior capsulotomy<sup>28</sup>. It may occur between 3 weeks and 11 months following capsulotomy. One prospective study provides evidence that incidence of new Cystoid macular oedema is low following laser capsulotomy, although some patients may acquire Cystoid macular oedema during prolonged follow-up study. Stark and

colleagues concluded that the risk of Cystoid macular oedema could be lowered by a long interval between extracapsular cataract extraction and laser capsulotomy<sup>28,33</sup>.

## **Retinal Detachment**

Retinal detachment may complicate Nd:YAG laser capsulotomy in 0.08% to 3.6% eyes<sup>33,34</sup>. A retinal detachment may occur early after the laser capsulotomy or more than a year later. Myopia, history of retinal detachment in other eye, younger age, and male sex are risk factors for retinal detachment following YAG laser capsulotomy.

## **Intraocular lens damage**

Pitting of intraocular lenses occurs in 15% to 33% of eyes during posterior capsulotomy<sup>6,11</sup>. The pitting usually is not visually significant, although rarely the damage may cause sufficient glare and image degradation that the damaged intraocular lens must be explanted. The type and extend of lens damage is dependent upon the material used in the intraocular lens<sup>6,11</sup>. Glass intraocular lens may be fractured by

## LASER MARKINGS OVER IOL



Nd:YAG laser, polymethyl methacrylate intraocular lenses sustain cracks and central defects with radiating fractures. Moulded polymethyl methacrylate lenses are more easily damaged than higher molecular weight lathe-cut lenses. Damage to silicon lenses is characterized by blistered lesions and localised pits surrounded by multiple tiny pits.

The frequency of lens damage is dependent upon the intraocular lens style. Intraocular lenses designed with a ridge separating posterior capsule from intraocular lens sustain less damage than lenses with a convex posterior surface and close apposition between posterior chamber intraocular lens and posterior capsule<sup>3</sup>.

### **Endophthalmitis:**

Several cases of propionibacterium acnes Endophthalmitis have been reported following capsulotomy. Eyes develop significant uveitis and loss of vision. Presumably the capsulotomy created an opportunity for the organisms sequestered within the capsule to reach the vitreous and develop into endophthalmitis<sup>5</sup>.

## Other complications

- Iritis-less than 1% eyes
- Macular Holes-rare<sup>4</sup>
- Corneal endothelial cell loss-2.3 to 7%

# ***REVIEW OF LITERATURE***

## REVIEW OF LITERATURE

### *1) Nd:YAG laser posterior capsulotomy-first 100 cases at UCLA*

*Kathym M. Gardner, Bradley R. Straatsma: J Ophthalmic Surgery  
1985; 16.*

Initial anatomic success was reported in 97% of the first 100 Neodymium YAG laser posterior capsulotomies performed at the Jules Stein eye institute. Visual acuity improved in 90 patients. It was unchanged in five patients and decreased in five patients. In the five patients, with decreased visual acuity after posterior capsulotomy, the decrease was unrelated to capsulotomy and caused by progression of preexisting retinal disease.

### *2) 3000 YAG lasers in posterior capsulotomies: An analysis of*

*complications R.Shah, P. Gills and associates- J Ophthalmic*

*Surgery 1986;17;473* Visual acuity improved to 20/40 – 20/20

group in 89.9% of subjects. IOL markings occurred in 12%.

Transient elevation of IOP occurred in 8.5%. Cystoid macular



oedema – 0.68%. Retinal detachment – 0.17%. Hyphema 0.15%.  
Iritis – 0.1%

***3. Evaluation of visual function following ND:YAG laser posterior capsulotomy. Datiles MB, Lasa MS : J. Ophthalmolgy 1997 Aug :104; 1287 – 93.***

The authors analysed 24 consecutive patients before and after Nd:YAG laser posterior capsulotomy. In addition to the measurement of visual acuity, they also analysed the contrast sensitivity and glare disability. Results: Mean differences between pre-laser and post-laser measures were significantly different from zero. (1) contrast sensitivity, mean difference = 0.24 log units ( $p < 0.0001$ ). (2) High glare disability using pelli- Robson chart, mean difference = 0.15 log units ( $p = 0.004$ ); (3) visual acuity using ETDRS chart mean difference = 11 letters ( $p < 0.0001$ ). ND:YAG laser capsulotomy is shown to significantly improve visual acuity, contrast sensitivity and glare disability.

4. *Intracular pressure changes after Neodymium YAG capsulotomy*

*Howver RR, Marefat B: J.cataract Refract surg 1997, Jan- feb 23:115-20.*

This study comprised 101 eyes. All patients received 1 drop of apraclonidine HCl 0.5% 30 to 60 min before and then after Nd: YAG capsulotomy. Intraocular pressure was measured preoperatively and at 1hr, 24 hrs, 1 week and 1 month postoperatively. Results: within 24 hours after capsulotomy, no significant IOP elevations occurred. There was one case of modest IOP elevations at 1 week, none was seen at 4 weeks. There was no relation between change in IOP and number of laser pulses, energy per pulse or total energy.

5. C.A.G.M. vester, M.F. Bienfait, P.T.V.M. de jong Erasmus iversity.

Eye Hospital, schiedamsevet 545 causes, inevidence 1.1%, follow up > 6 months

6. *Retinal detachment after posterior capsulotomy with YAG laser*

*Hallaq E, Montard M.; J Fr Ophthalmol 1995 : 18: 733 - 45.*

24 cases were analysed to determine risk factors , etiology, management and prognosis. RD was total or subtotal in 25 % of cases.

The macula was detached in 58%. Anatomic success was achieved in 88% of cases. The proliferative vitreoretinopathy was the main cause of recurrence.

*7. Incidence of retinal detachment after cataract surgery and Nd :YAG laser capsulotomy. Powell SK, Olson RJ; J. cataract refract Surgery 1995, Mar:21:132-5.*

This study comprised of 1092 patients, who had cataract extraction, Of 1092, patients , 215 had Nd:YAG laser capsulotomy. The incidence of RD following phacoemulsification alone was 0.75% with a mean time between cataract extraction and RD of 11.6 months. The incidence of RD following ND:YAG laser capsulotomy was 0.82% (2/244) with a mean time of 32 months between cataract surgery and capsulotomy and 13.5 months between capsulotomy and RD. This study confirms the increased risk of RD following posterior capsule rupture and anterior vitrectomy.

8. *The barrier function in Neodymium – YAG laser capsulotomy; smith RT Moscoso WE; Arch Ophthalmol, 1995: May 113:645 – 52.*

21 eyes were analysed to measure the disruption of the anterior – posterior extracapsular barrier complex induced by Nd:YAG laser capsulotomy and to determine how it might be minimized. Results showed that both anterior vitreous disruption and absence of posterior chamber IOL were significantly correlated with loss of barrier efficiency and glaucoma occurred more frequently when barrier efficiency was lost postoperatively.

9. Chaudhary M et al

Nepal J. Ophthalmol 2011; 3(5): 80-82. A rare complication of Nd-YAG laser capsulotomy: propionibacterium aenes endophthalmitis. They come across one case recently and may be due to breakdown of barrier.

## *PART - II*

# **MATERIALS AND METHODS**

## **MATERIALS AND METHODS**

This prospective clinical study was done to analyse the results of Nd:YAG laser posterior capsulotomy in posterior capsular opacification following cataract surgery. This study was carried out at Government Rajaji Hospital, Madurai.

Eyes of 100 patients who underwent YAG laser posterior capsulotomy were studied. 8 patients were aphakic; 89 patients had posterior chamber intraocular lens and 3 patients had anterior chamber intraocular lens. Informed consent was obtained from all patients. Following data was collected from each patients.

- Age and sex
- Date of cataract surgery
- Presence and type of Intraocular lens
- Current eye medications & systemic medications
- Best corrected visual acuity with glasses by using Snellen chart.
- Anterior segment examination with oblique illumination and then with slit lamp examination.

- Intraocular pressure measurement with Schiotz tonometry
- Fundus examination with direct ophthalmoscopy and indirect ophthalmoscopy if necessary.

The posterior capsulotomies were performed with Nd:YAG laser, usually starting with 1 – 2 mj / pulse and gradually increased until the desired responses were obtained.

Following points were noted:

- Pulse energy, number of pulses
- Operative complications

Immediately after capsulotomy, timolol 0.5% eye drops was applied to each patient and tablet acetazolamide 250mg twice a day was given. Antiglaucoma medications were continued depending upon the intraocular pressure changes during follow up period. Steroid eye drops were prescribed for all the patients for 1 week after the capsulotomy. Post laser follow up was done after 1 hour, 24 hours, 1 week, 1 month and 3 months.

During each visit, following data was recorded.

- Visual acuity with Snellen chart
- Intraocular pressure with Schiotz tonometry



- Slit lamp examination
- Fundus examination with direct and indirect ophthalmoscopy
- Post laser complications

## **OBSERVATIONS AND RESULTS**

## OBSERVATIONS AND RESULTS

Total number of patients – 100

RE – 45 eyes

LE – 55 eyes

Table 1. Age Distribution

<b>Age</b>	<b>Cases</b>
1 to 20	5
21 to 40	6
41 to 60	45
>60	44

Table 2. Sex distribution

<b>Sex</b>	<b>Cases</b>
<b>Males</b>	46
<b>Females</b>	54

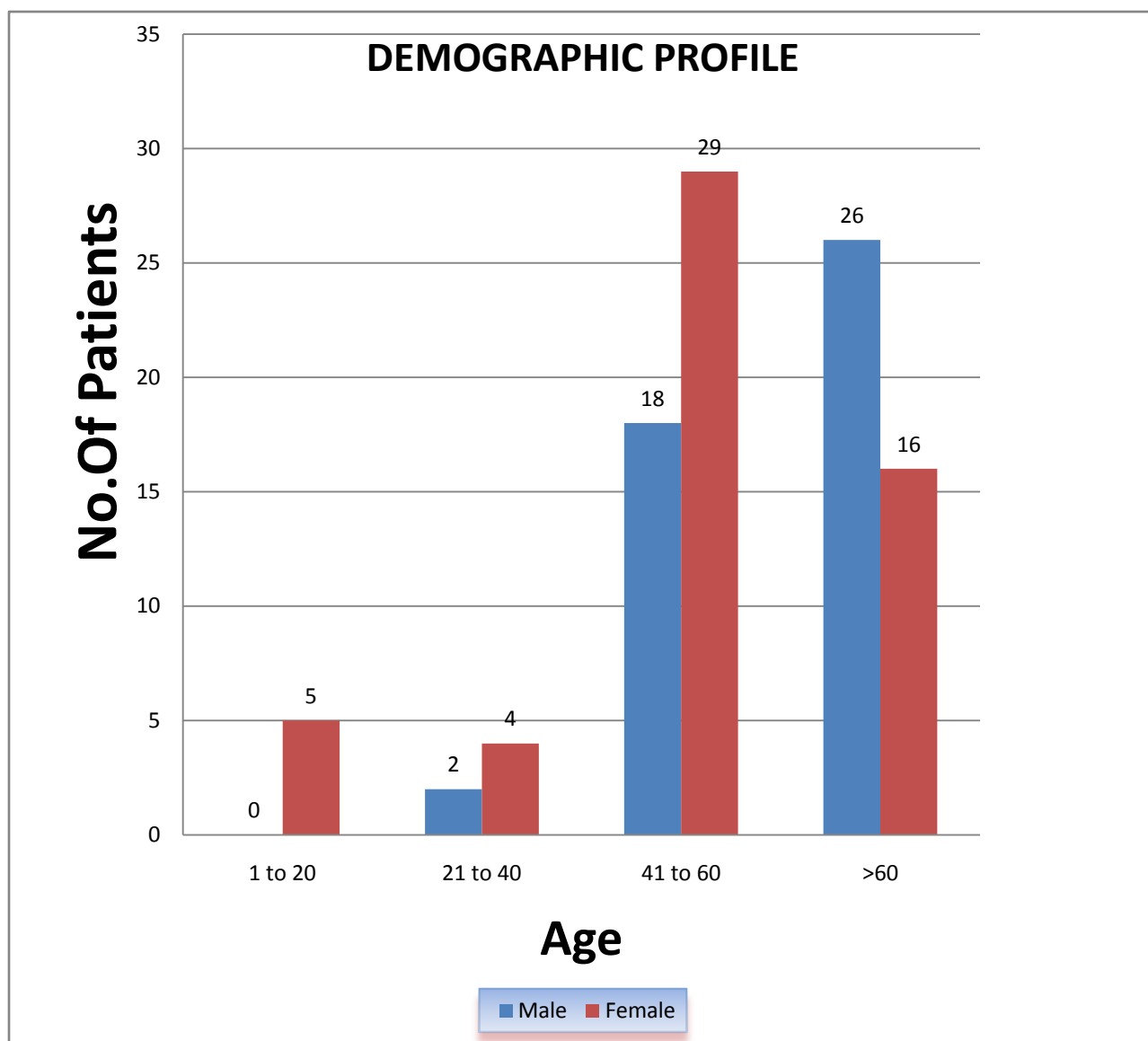


Table 3: Type of surgery

<b>Types of Surgery</b>	<b>Cases</b>
<b>PI.E.C.C.E</b>	8
<b>PC IOL</b>	89
<b>AC IOL</b>	3

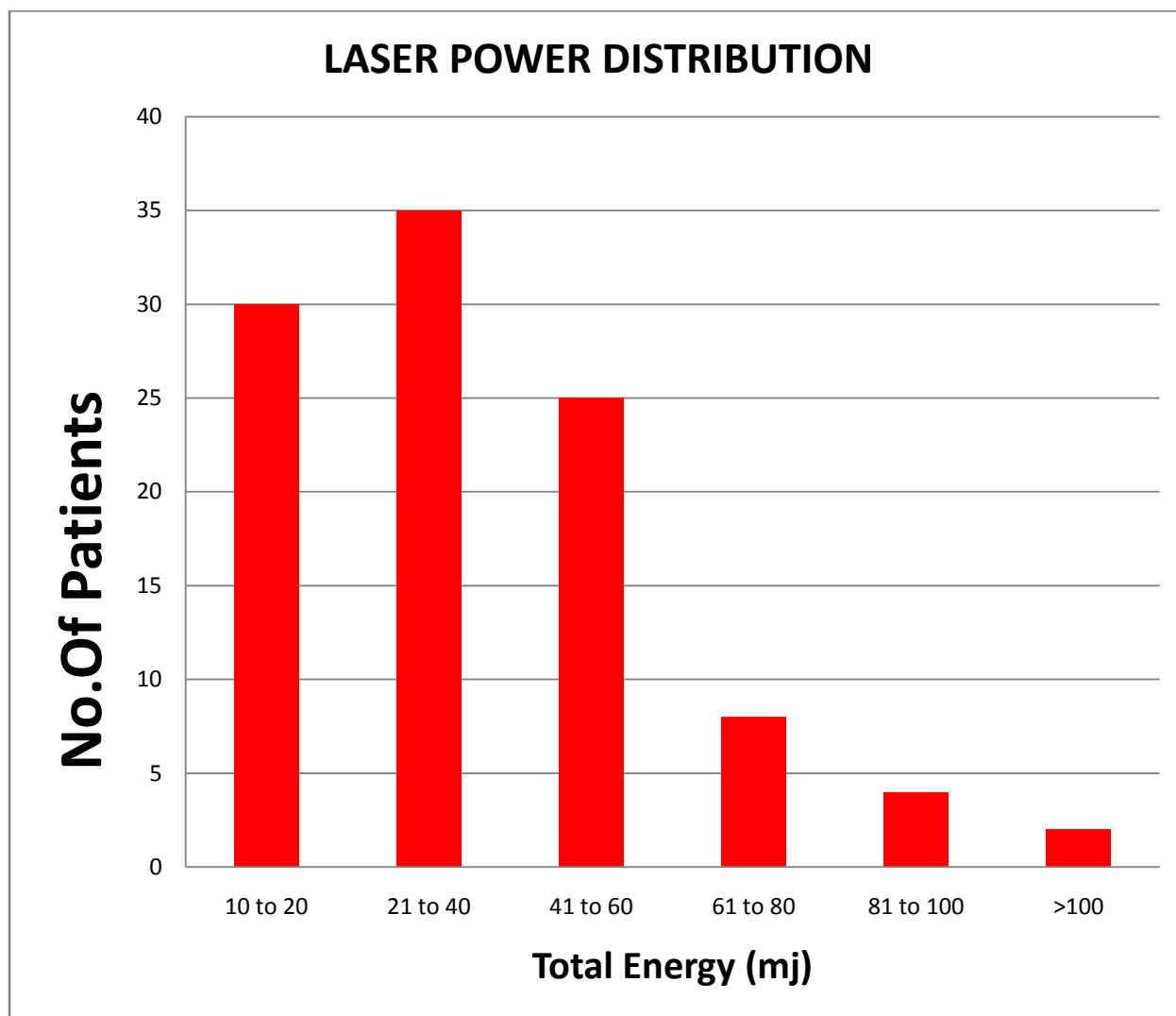
Table 4: Time Interval between cataract surgery and development of posterior capsular opacification.

<b>Duration</b>	<b>Cases</b>
<b>6 months – 1 year</b>	44
<b>&gt;1 year-1<sup>1/2</sup>years</b>	29
<b>&gt;1<sup>1/2</sup>years -2 years</b>	17
<b>&gt;2 year-2<sup>1/2</sup>years</b>	4
<b>2<sup>1/2</sup>years- 3 years</b>	4
<b>&gt;3 years</b>	2

44% cases of posterior capsular opacification were noted between 6 months to 1 year after cataract surgery. 29% of cases were noted between 1 to 1<sup>-1/2</sup> years after cataract surgery. 2 cases of posterior capsular opacification were noted after 3 years – one at 3<sup>1/2</sup> years and another case at 4 years after cataract extraction. Cases, which had developed posterior capsular opacification within 3 – 6 months following cataract surgery, were advised to come after 6 months and posterior studies report a less incidence of complications when laser capsulotomy was done after a longer interval following cataract surgery.

Table 5: Laser power distribution

<b>Total Energy (mj)</b>	<b>Cases</b>
<b>10 to 20</b>	29
<b>21 to 40</b>	34
<b>41 to 60</b>	26
<b>61 to 80</b>	7
<b>81 to 100</b>	3
<b>&gt;100</b>	1



The posterior capsulotomies were performed with Nd: YAG laser starting with 1 – 2 mj/pulse and gradually increased until the desired response were obtained. In most cases, desired response was obtained within the total energy of 50 mj. However, in certain cases, more than 100 mj were used because of thick posterior capsule.

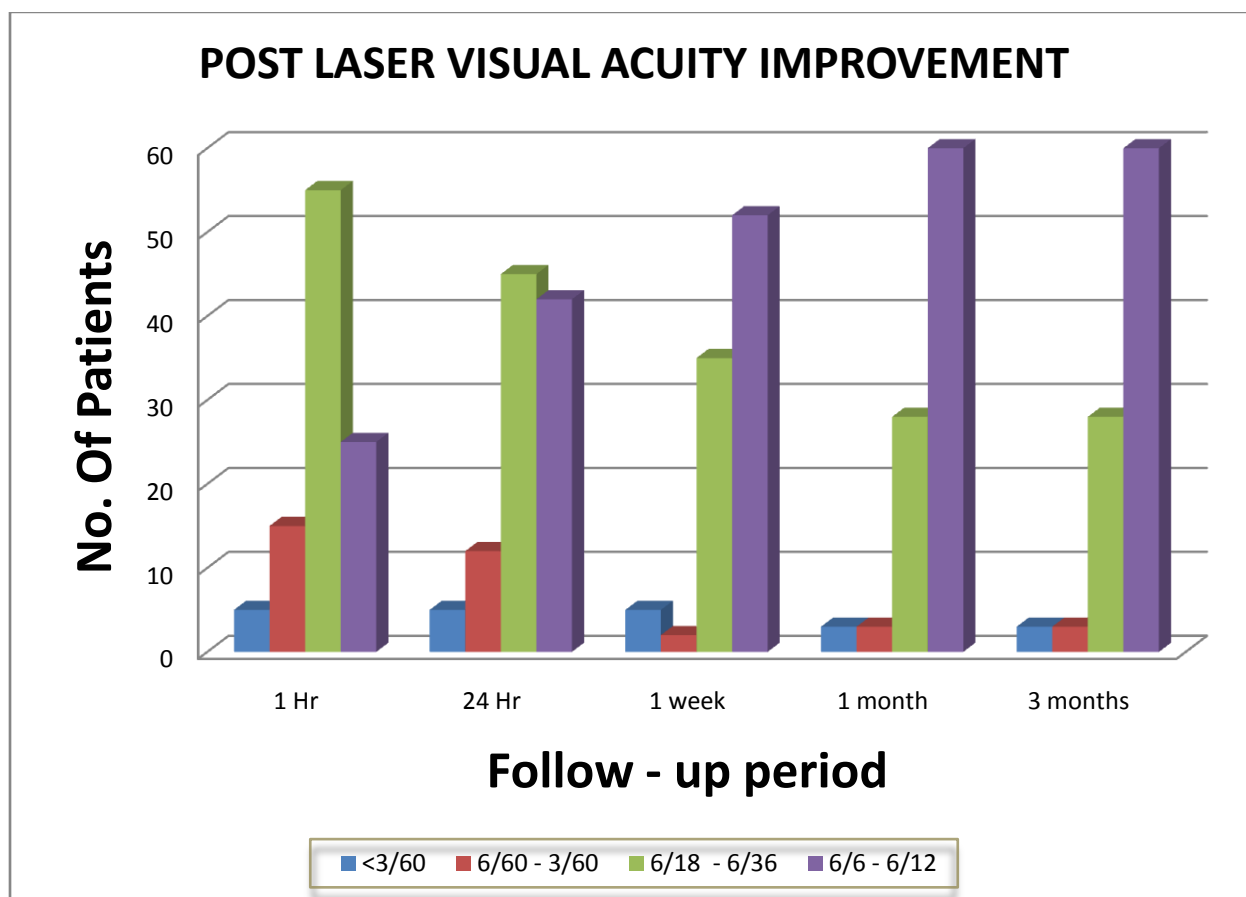
Table 6: Pre laser visual capsule

<b>Visual Acuity</b>	<b>&lt;3/60</b>	<b>6/60 – 3/60</b>	<b>6/18 -6/36</b>
<b>Cases</b>	10	75	15

Table 7: Post laser visual Acuity improvement.

<b>Follow up</b>	<b>&lt;3/60</b>	<b>6/60 – 3/60</b>	<b>6/18 -6/36</b>	<b>6/6 – 6/12</b>
<b>1 Hr.</b>	4	12	57	27
<b>24 Hrs.</b>	4	10	45	41
<b>1 week</b>	4	1	39	56
<b>1 month</b>	2	2	31	65
<b>3 months</b>	2	2	30	66





Visual acuity profile reveals that 75% of patients had visual acuity in the range between 6/60 to 3/60 and 10% of patients had visual acuity less than 3/60 before doing YAG laser posterior capsulotomy.

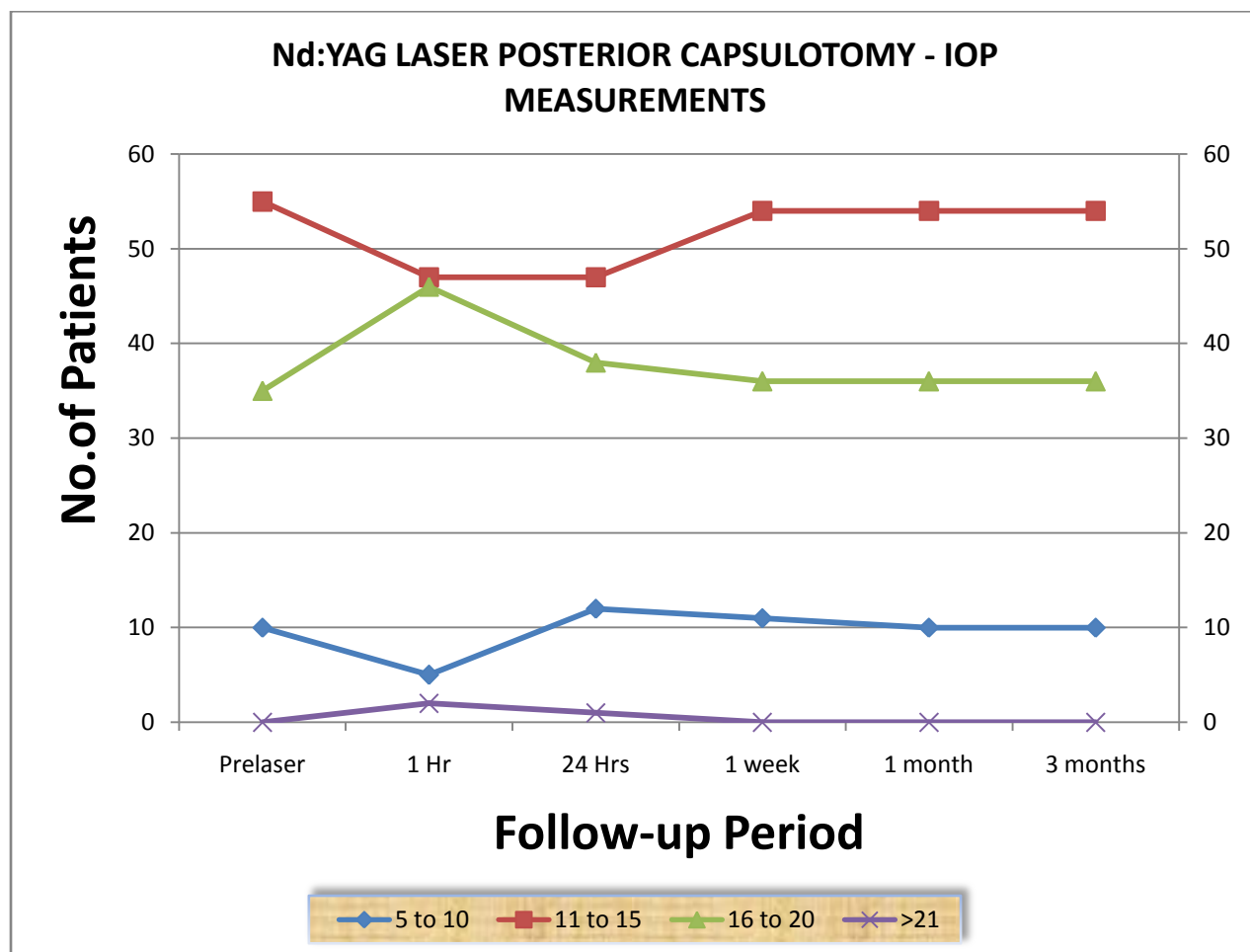
Immediately after doing YAG laser capsulotomy within one hour, 57% of patients had improved visual acuity of 6/18 to 6/36 and 27% patients had better visual acuity of 6/6 to 6/12. The percentage of patients with better visual acuity had increased gradually during follow up period – at 24 Hours, 1 week, 1 month and 3 months. At the end of 3 months, 66% of patients had visual acuity of 6/6 to 6/12 and 30% of patients had visual acuity of 6/18 to 6/36. The vision of 4% of subjects was not improved by laser capsulotomy. Among 4 cases, 2 cases showed optic atrophy, one case presented with retinitis pigmentosa with consecutive optic atrophy, inability to penetrate thick posterior capsule in one case.

Table 8: Nd: YAG laser posterior capsulotomy - IOP measurement.

<b>IOP(mmHg)</b>	<b>Prelaser</b>	<b>1 Hr</b>	<b>24 Hrs</b>	<b>1 week</b>	<b>1 Months</b>	<b>3 Months</b>
<b>5 to 10</b>	10	5	13	11	10	10
<b>11 to 15</b>	55	47	47	54	55	55
<b>16 to 20</b>	35	46	39	35	35	35
<b>&gt;21</b>		2	1			

Intraocular pressure was measured at 1 hour, 24 hours, one week and three months after Nd:YAG laser capsulotomy. In this analysis, 30% of cases showed transient elevation of intraocular pressure, within normal range of 20mm Hg. Only 2 cases showed intraocular pressure of more than 21 mm Hg. One case showed 30.8 mm Hg at 1 hour and 31.8 mm Hg at 24 hours. This patient was treated with timolol 0.5% eye drops and acetazolamide tablet 250 mg twice daily for 1 week and at the end of 1 week, IOP became normal. Another case showed 30.2 mm Hg at 1 hour and returned to normal at 24 hours. No case showed increased intraocular pressure at 1 week, 1 month and 3 months following Nd:YAG laser capsulotomy.

In 4% of cases, intraocular pressure was reduced to 2-4 mm Hg from their preoperative level and returned to normal at 1 week, 1 month and 3 months follow-up. This decreased intraocular pressure was attributed due to application of timolol 0.5% eye drops, immediately after capsulotomy.



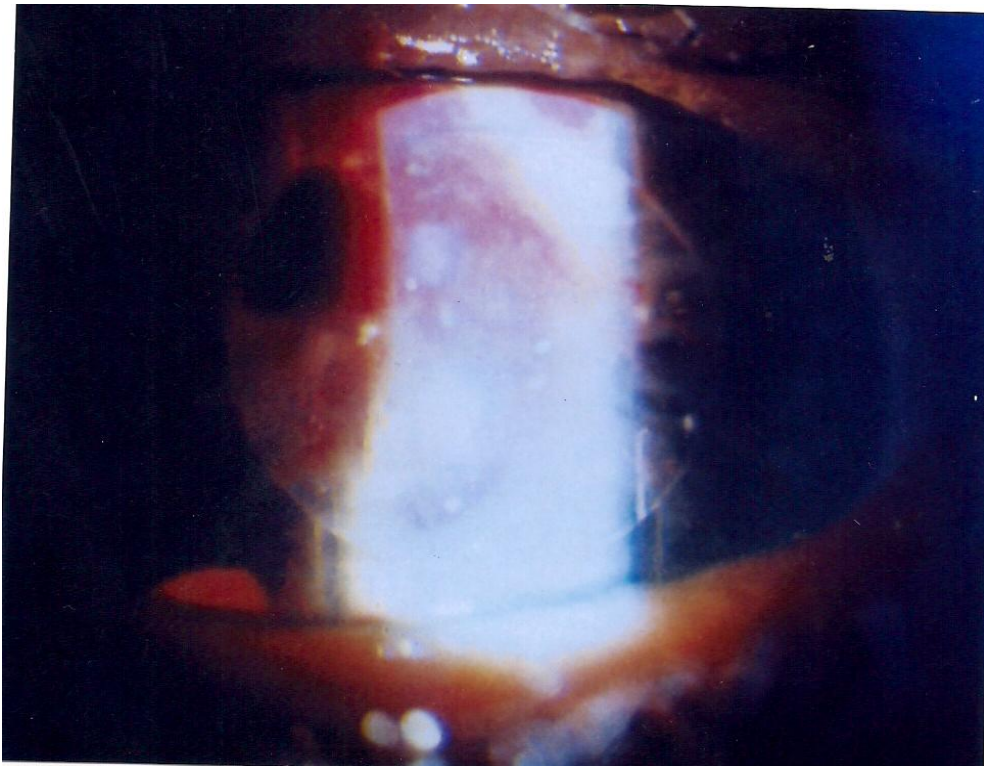
In all cases, timolol 0.5% eye drops was applied immediately after procedure and tablet acetazolamide 250 mg twice for 1 day was given. Steroid eye drops were prescribed for 1 week. Because of these reasons, intraocular pressure was not much raised in this study after Nd : YAG laser capsulotomy.

Table 9: Complications following Nd : YAG laser capsulotomy

COMPLICATIONS	Cases
Intraocular Pressure elevation	2
Iris bleeding	4
Intraocular lens damage	23
Vitreous into Anterior chamber	4
Uveitis	1
Cystoid macular oedema	0
Retinal Detachment	0
Endophthalmitis	0

Intraocular pressure elevation more than 21 mm Hg were noted in 2% of cases. It was detected at 1 hour and 24 hours after YAG laser capsulotomy and they were returned to normal level within 1 week after treating with Timolol 0.5% eye drops and tablet acetazolamide twice daily.

## IRIS BLEEDING



# **DISCUSSION**

## DISCUSSION

The documented visual improvement of the subjects in this study confirms the efficacy of Nd:YAG laser for the production of posterior capsulotomy. This noninvasive surgical laser allows omission of primary intraoperative capsulotomy, with its increased risk of intraocular lens and vitreous displacement, cystoid macular oedema and retinal detachment. In this report, the results of present study are compared with previous studies.

M.Gardner, R.Straatsma (1985) analysed 100 cases of ND:YAG laser posterior capsulotomy. They reported that 48% increase in the number of subjects with 20/15 to 20/40 vision at 24 hours. At one week, 73% of entire population was in the 20/15 to 20/40 group and the 29% initially in the 20/200 – 20/400 group had dropped to 1%. The vision of 5% subjects was not improved by laser capsulotomy due to documented progression of preexisting retinal disease.

Dick B, Scheween O (1997) stated that visual acuity improved in 93.6% of cases.



In our study, 96% of subjects showed significant visual acuity improvement. At 24 hours after capsulotomy 27% of patients had the visual acuity of 6/6 to 6/12 and at 3 months it was increased up to 66%. 75% of patients initially with visual acuity of 6/60 to 3/60 (prelaser) had dropped to 2% after capsulotomy. The vision of 4% of subjects was not improved by laser capsulotomy. In this, 2 patients had optic atrophy, 1 patient had retinitis pigmentosa with consecutive optic atrophy. One patient, who underwent IOL implantation following traumatic cataract, developed thick posterior capsular opacification, which could not be penetrated even with maximum energy of 220mj done twice. Posterior capsulotomy was done for 5 cases of intraocular lens implantation following traumatic cataract- vision improved in 4 cases.

Gardner and associates (1985) reported that the percentage of subjects in the > 20 mm Hg group increased 20% from 8.4% preoperatively to 28.4% at 24 hours. At 24 hours, 23% of subjects demonstrated a >5 mm Hg increase in IOP over preoperative levels, 11% >10 mm Hg and 5% >20 mm Hg.

Dick B(1997) analysed 31 cases and intraocular pressure rise was noted in only one case.

In present study, 2% of subjects showed increased intraocular pressure more than 21 mm Hg. The IOP returned to the normal level within 1 week. However, transient elevation of IOP of 3-5 mm Hg from their basal level was noted in 30% of subjects within 24 hours but not exceeding 20 mm Hg. The most likely mechanism for acute pressure elevation is trabecular blockage by capsular and cortical debris. In this study group, timolol 0.5% eye drops was applied immediately after the procedure and tablet acetazolamide twice a day was given to all patient. So that, lower incidence of intraocular pressure elevation was noted in this present study.

Although the actual and theoretical advantages of Nd:YAG laser capsulotomy is impressive, its use has been associated with both intraoperative and postoperative complications.

Gardner (1985) reported 3% incidence of Iris bleeding with resulting minimal hyphema.

Gardner reported that 4% of study subjects required a second Nd:YAG procedure because of inadequacy or closure of capsulotomy.

In present study, a second Nd:YAG procedure was done in 4% of study subjects because of inadequacy. Except one, other 3 cases showed improved visual acuity after repeat capsulotomy. In some cases, the need for a second procedure might be avoided by careful preoperative capsular drawings with documentation of visual axis.

Terry Ac, Apple DJ (1983) reported intraocular lens damage in 12 of 30 eyes with intraocular lens implants.

Gardner (1985) reported 39% of subjects with intraocular lens damage.

In present study, intraocular lens pitting was noted in 23 out of 92 (25%) subjects. Lens pitting is most likely to occur when lens and capsule are closely approximately. This had no deleterious effect on visual acuity and did not produce the post treatment inflammation that might have been expected with release of toxic monomers. However, the long-term effects of even minor lens damage with possible release of toxic components are not known. Special care should therefore be taken to avoid lens injury. Application of laser energy to a point behind

the posterior capsule allows the anterior reflection of shock wave to disrupt the posterior capsule rather than the intraocular lens. Use of the lowest possible energy in trains of one pulse per burst further decreases the risk to the lens. Accurate focus is essential and is aided by use of Nd:YAG contact lens.

Terry AC, Apple DJ (1983) reported that rupture of vitreous into anterior chamber occurred in 6 of 19 eyes without IOL. In present study, rupture of anterior hyaloids face with forward displacement of vitreous into anterior chamber occurred in 4 out of 8 (50%) subjects. Visual improvement in these patients did not seem to be adversely affected. We do not know if the anterior displacement of vitreous increases the chances of late onset macular oedema or corneal oedema. To reduce the chances of rupturing anterior hyaloid face when no intraocular lens is present, the laser beam should be focused anterior to the capsule and then moves slowly to the posterior.

Gardner reported postoperative uveitis in 13% of subjects.

R.Shah,P.Gills (1985) reported 0.1% subjects of postoperative uveitis.

In present study, postoperative uveitis was reported in 1% of subjects at one-week follow up. Inflammation is produced by liberation of large amounts of lens cortex into anterior chamber. These patients may benefit from perioperative treatment with topical anti-inflammatory agents. Many patients with early postoperative aqueous cells and flare appear to have persistent suspended capsular debris without a significant inflammatory component and can best be managed with observation and monitoring of intraocular pressure.

F. Steinert, Puliafito (1991) reported 11 patients (1.23%) developed cystoid macular oedema.

R. Shah (1985) reported that cystoid macular oedema occurred in 0.68% of subjects.

In this study group, no evidence of cystoid macular oedema was noted in any patient within 3 months follow-up period. Cystoid macular oedema may occur between 3 weeks and 11 months following capsulotomy.

Stark and colleagues concluded that the risk of cystoid macular oedema could be lowered by a longer interval between extracapsular cataract extraction and laser capsulotomy.

Incidence of retinal detachment after Nd:YAG laser capsulotomy in various studies is:

Aron Rosa, Aron (1984) – 0.1%

Stark & associates (1985) – 0.5%

Steinert & associates (1991) – 1.23%

In present study, retinal detachment was not seen in my patients. Two proposed mechanisms producing RD include inadvertent production of peripheral retinal break and retinal traction caused by vitreous displacement. A retinal detachment may occur early after laser capsulotomy or more than a year later. Myopia, a history of retinal detachment in other eye, younger age and male sex are risk factors for retinal detachment following Nd:YAG laser posterior capsulotomy.

Several cases of propionibacterium acnes endophthalmitis have been reported following Nd:YAG laser posterior capsulotomy. In this study, no case was reported. Following laser capsulotomy, the eyes develop

significant uveitis and loss of vision. Presumably, the capsulotomy creates an opportunity for the organisms sequestered within the capsule to reach the vitreous and develop into endophthalmitis.

Posterior capsulotomy with Nd:YAG laser offers many advantages over primary or secondary surgical capsulotomy. Undesirable associated findings can be avoided or minimized through careful preoperative evaluation, skilled operative technique and appropriate postoperative management.

# **SUMMARY**



## SUMMARY

1. This clinical study was done at the Department of Ophthalmology, Govt. Rajaji Hospital, Madurai.
2. A total of 100 patients were examined. Out of them 44 were males and 56 were females.
3. 8 patients were aphakic and 92 patients were pseudophakic (89 had PC-IOL and 3 had AC-IOL).
4. Nd:YAG laser posterior capsulotomy was done within 6 months to 1 year following cataract surgery in about 53 patients.
5. Posterior capsulotomies were done with minimum laser energy of 10 mj upto maximum level of 220 mj.
6. Significant visual improvement was seen in 96% patients; 4 patients showed no visual improvement, which was related to previous retinal problems and thick posterior capsule.
7. Transient elevation of intraocular pressure above 21 mm of Hg was noted in 2 patients within 24 hours. No case was found to have elevated IOP at follow up period (1 week, 1 month and 3 month).

8. Repeat YAG laser capsulotomy was done in 4 patients because of inadequacy of previous capsulotomy. Except one, other three cases showed improved visual acuity after the repeat YAG capsulotomy.
9. Iris bleeding was noted in 4 patients during the procedure, which resolved within one day.
10. Intraocular lens pitting occurred in 23 patients.
11. Rupture of anterior hyaloid face with forward displacement of vitreous into anterior chamber occurred in 4 patients.
12. Post –laser uveitis had developed in 1 patient which was controlled with steroid eye drops and anti-inflammatory drops within 1 week.
13. No case had been found to develop cystoid macular oedema, retinal detachment or endophthalmitis within 3 months follow-up period.

# **CONCLUSION**

## CONCLUSION

In the past, intracapsular cataract extraction was done for most of the patients. Nowadays, most of the ophthalmic surgeons are doing extracapsular cataract extraction with intraocular lens implantation. Following extracapsular cataract surgery, increased incidence of posterior capsular opacification has been noted. The opening of posterior capsule by invasive surgical means has been noted to cause certain complications such as cystoid macular oedema and retinal detachment. The Nd:YAG laser is a noninvasive surgical tool that provides excellent posterior capsulotomies.

From the above study, it is clear that Nd:YAG laser posterior capsulotomy is a safe and effective procedure for creating capsular opening. The postoperative results are very good and the complication rate is low.

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***PROFORMA***

## CLINICAL STUDY - PROFORMA

Name : Age: Sex:

YAG laser No. : O.P/I.P No:

Laterality : RE LE

Type of surgery : PI.ECCE/PCIOL/ACIOL

Date of cataract surgery :

Prelaser Evaluation :

(1)Visual Acuity with correction :

(2) Intraocular Pressure :

(3) Slit lamp examination :

(4) Fundus :

Laser setting:

(1)Energy level :

(2)Pulse :

(3)No of exposures :

Post – laser follow – up:

- 1 hr – Visual Acuity
  - Intraocular pressure
- 24 hrs - Visual Acuity
  - Intraocular pressure
  - Slit lamp examination
  - Fundus
- 1 wk - Visual Acuity
  - Intraocular pressure
  - Slit lamp examination
  - Fundus
- 1 month - Visual Acuity
  - Intraocular pressure
  - Slit lamp examination
  - Fundus
- 3 months - Visual Acuity
  - Intraocular pressure
  - Slit lamp examination
  - Fundus

# **ABBREVIATIONS**

**LASER – LIGHT AMPLIFICATION STIMULATED EMISSION OF RADIATION**

**Nd :YAG – NEODYMIUM YITTRIUM ALUMINIUM GARNET**

**ECCE : EXTRA CAPSULAR CATARACT EXTRACTION**

**IOL : INTRA OCULAR LENS**

**PCIOL: POSTERIOR CHAMBER INTRAOCULAR LENS**

**ACIOL: ANTERIOR CHAMBER INTRAOCULAR LENS**

**IOP : INTRAOCULAR PRESSURE**

**FFA : FUNDUS FLOUREISENCE ANGIOGRAPHY**

**RE : RIGHT EYE**

**LE : LEFT EYE**

**OP : OUT PATIENT**

**IP : IN PATIENT**

# ***MASTER CHART***



No	Name	IP/O P No	LATERALITY	Age	Sex	Type of Surgery*	Duration (years)	Pre Laser		Laser Energy Level	Post Laser visual Acuity					Post Laser IOP					Complications
								Visio n	IOP	mj	1 Hr	24 Hr	1 wk	1 Mn	3 Mns	1 Hr	24 Hrs	1 Wk	1 Mn	3 Mns	
1	Ayyavu	409091	R	73	M	1	2	6/60	14.6	46	6/24	6/24	6/18	6/18	6/12	14.6	14.6	12.8	14.6	14.6	
2	Kannaian	399011	R	70	M	1	1	2/60	12.8	49	6/60	6/60	6/36	6/36	6/36	14.6	14.6	12.8	12.8	12.8	
3	Shanmugam	408678	L	60	M	1	6/12	6/60	14.6	140	6/24	6/24	6/18	6/18	6/18	17.3	17.3	14.6	14.6	14.6	Multiple IOL markings
4	Rajammal	484733	R	56	F	1	1 <sup>1/2</sup>	1/60	17.3	10	6/12	6/12	6/9	6/9	6/9	17.3	17.3	17.3	17.3	17.3	
5	Lakshmi	446019	L	64	F	1	2	4/60	14.6	12	6/12	6/12	6/9	6/9	6/9	17.3	17.3	14.6	14.6	14.6	
6	Kamatchi	430612	L	48	F	1	1	6/24	12.2	86	6/18	6/18	6/12	6/12	6/12	17.3	14.4	12.2	12.2	12.2	Laser Markings over IOL
7	Subbaiah	431230	L	65	M	1	8/12	5/60	17.3	150	6/12	6/12	6/12	6/12	6/12	17.3	14.4	14.4	14.4	14.4	
8	Narayanammal	507817	R	63	F	1	10/12	6/60	17.3	40	6/36	6/18	6/18	6/18	6/18	14.4	17.3	17.3	17.3	17.3	
9	Rakku	482093	L	55	F	1	2 <sup>1/2</sup>	6/60	17.3	20	6/18	6/18	6/12	6/12	6/12	30.8	31.8	17.3	17.3	17.3	Increased IOP
10	Banumathi	507916	R	38	F	1	1 <sup>1/4</sup>	6/36	12.2	54	6/18	6/18	6/18	6/18	6/18	12.2	14.6	14.6	14.6	14.6	
11	Ayyammal	358066	R	70	F	1	1	4/60	10.2	18	6/60	6/60	6/36	6/36	6/18	10.2	10.2	12.2	12.2	12.2	Laser Markings over IOL
12	Pechi Thevar	388695	L	49	M	1	3	6/36	14.6	45	6/18	6/12	6/12	6/12	6/12	14.6	12.2	12.2	12.2	12.2	
13	Subbulakshmi	478738	L	63	F	1	1	6/36	17.3	20	6/24	6/18	6/18	6/18	6/18	14.4	14.4	17.3	17.3	17.3	
14	Neshakirubamani	359032	L	55	F	1	1 <sup>1/2</sup>	3/60	17.3	94	6/36	6/12	6/12	6/12	6/6	17.3	17.3	17.3	17.3	17.3	
15	Ammani	482939	R	60	F	1	1	4/60	12.2	84	6/18	6/12	6/12	6/12	6/12	17.3	12.2	12.2	12.2	12.2	
16	Ganesan	505388	R	65	M	2	1	6/60	12.2	14	6/15	6/12	6/12	6/12	6/12	12.2	12.2	14.4	14.4	14.4	Iris Bleeding
17	Raju	465225	R	65	M	1	6/12	2/60	10.2	12	6/12	6/12	6/9	6/9	6/9	12.2	12.2	12.2	12.2	12.2	Laser Markings over IOL
18	Kalyani	497020	L	45	F	1	10/12	4/60	10.2	12	6/60	6/60	6/36	6/24	6/24	14.4	10.2	10.2	10.2	10.2	
19	Periyaponnu	447007	R	65	F	2	2	6/60	10.2	50	6/18	6/18	6/18	6/18	6/12	10.2	10.2	10.2	10.2	10.2	IOL markings

20	Arivazhagan	469157	L	75	M	1	1 <sup>1/2</sup>	6/60	14.6	39	6/36	6/24	6/6	6/6	6/6	30.2	10.2	14.6	14.6	14.6	Increased IOP
21	Valliammal	486495	R	55	F	1	2	6/60	12.2	11	6/18	6/18	6/18	6/12	6/12	14.8	14.8	12.2	12.2	12.2	Laser Markings over IOL
22	Thangasamy	416482	L	54	M	1	1	6/60	14.6	11	6/12	6/12	6/12	6/12	6/12	14.6	10.2	14.6	14.6	14.6	
23	Chandran	506165	L	56	M	1	1 <sup>1/2</sup>	3/60	12.2	11	6/36	6/24	6/12	6/12	6/12	14.6	12.2	14.6	12.2	12.2	
24	Sivaraman	456052	R	58	M	1	8/12	5/60	17.3	132	5/60	5/60	5/60	5/60	5/60	12.2	12.2	14.4	14.4	14.4	
25	Saminathan	475920	L	56	M	1	2	4/60	12.2	112	6/36	6/24	6/12	6/12	6/12	14.6	14.6	12.2	12.2	12.2	
26	Jothiammal	455793	R	65	M	1	1 <sup>1/2</sup>	6/36	12.2	54	6/24	6/24	6/18	6/18	6/18	14.6	14.6	12.2	12.2	12.2	Laser Markings over IOL
27	Perumal Akka	484025	L	70	F	1	3	5/60	12.2	148	6/36	6/36	6/24	6/24	6/24	14.4	12.2	12.2	12.2	12.2	
28	Mohammed Ibrahim	422488	L	62	M	1	4	5/60	14.6	16	6/18	6/12	6/12	6/12	6/9	14.6	14.6	14.6	14.6	14.6	
29	Janaki	492489	L	40	F	1	3	3/60	17.3	46	6/60	6/60	6/36	6/36	6/36	17.3	17.3	17.3	17.3	17.3	
30	Subathra	466244	L	35	F	1	1	4/60	17.3	128	6/36	6/36	6/36	6/24	6/24	14.8	14.8	17.3	17.3	17.3	
31	Perumayee	450640	L	78	F	1	1 <sup>1/4</sup>	6/60	17.3	25	6/36	6/36	6/24	6/18	6/18	17.3	17.3	14.6	14.6	14.6	Laser Markings over IOL
32	Pavithra	509156	R	16	F	1	1	6/36	17.3	140	6/24	6/18	6/12	6/12	6/12	17.3	17.3	17.3	17.3	17.3	
33	Mariammal	486187	L	70	F	2	1	5/60	10.2	102	6/60	6/36	6/36	6/36	6/18	14.6	14.6	10.2	10.2	10.2	
34	Rajamani	443472	R	68	F	1	2	6/24	12.2	40	6/12	6/12	6/6	6/6	6/6	12.2	12.2	12.2	12.2	12.2	
35	Thambiraja	392313	L	78	M	2	1 <sup>1/2</sup>	6/60	12.2	30	6/18	6/18	6/12	6/9	6/9	14.6	14.6	12.2	12.2	12.2	Iris Bleeding
36	Rasu thevar	456249	L	65	M	1	1	6/36	17.3	10	6/12	6/18	6/18	6/9	6/9	17.3	17.3	14.8	17.3	17.3	Laser Markings over IOL
37	Gayathri	413151	R	11	F	2	1	3/60	12.2	75	6/60	6/36	6/36	6/36	6/36	14.8	12.2	12.2	12.2	12.2	
38	Karuppaye	435001	R	65	F	1	2	6/60	12.3	29	6/12	6/12	6/12	6/9	6/9	14.6	12.2	12.2	12.2	12.2	
39	Suja	491408	L	17	F	1	6/12	6/60	12.2	75	6/12	6/12	6/6	6/6	6/6	14.4	12.2	12.2	12.2	12.2	Laser Markings over IOL
40	Aishwarya	460027	L	20	F	1	4	6/60	10.2	75	CFCF	CFCF	CFCF	CFCF	CFCF	12.2	10.2	10.2	10.2	10.2	
41	Thendral	479257	L	37	F	1	3	3/60	17.3	49	6/12	6/9	6/9	6/9	6/9	17.3	14.6	14.6	17.3	17.3	Laser Markings over IOL
42	Rajamani	429241	R	65	F	1	2	5/60	14.6	56	6/36	6/36	6/36	6/12	6/12	17.3	17.3	14.6	14.6	14.6	Iris Bleeding
43	Meena	430106	L	13	F	1	1 <sup>1/2</sup>	1/60	17.3	220	1/60	1/60	1/60	1/60	1/60	17.3	17.3	17.3	17.3	17.3	
44	Manickam	500084	R	75	M	1	1	6/24	17.3	95	6/12	6/6	6/6	6/6	6/6	17.3	17.3	17.3	17.3	17.3	
45	Thulasi	470247	L	66	M	1	1	1 <sup>1/2</sup> /60	14.6	53	1 <sup>1/2</sup> /60	1 <sup>1/2</sup> /60	1 <sup>1/2</sup> /60	1 <sup>1/2</sup> /60	1 <sup>1/2</sup> /60	14.6	14.6	14.6	14.6	14.6	
46	Arokiamary	469943	L	73	F	1	6/12	3/60	14.6	81	6/60	6/60	6/18	6/12	6/12	20.3	17.3	14.6	14.6	14.6	
47	Mymoon beevi	398712	R	65	F	1	8/12	6/36	17.3	46	6/24	6/18	6/18	6/18	6/18	17.3	17.3	14.6	14.6	14.6	IOL Markings

48	Kumaran	450487	R	50	M	1	6/12	5/60	14.4	54	6/36	6/18	6/18	6/18	6/18	20.3	20.3	14.4	14.4	14.4	
49	Ramamoorthy	410325	L	50	F	1	1 <sup>1/2</sup>	3/60	17.3	60	6/12	6/12	6/12	6/12	6/9	17.3	17.3	17.3	17.3	17.3	Laser Markings over IOL
50	Arumugam	476387	R	60	M	1	1 <sup>1/4</sup>	6/60	12.2	43	6/18	6/18	6/18	6/12	6/12	17.3	17.3	12.2	12.2	12.2	
51	Thotichi Ammal	506793	L	49	F	1	2	3/60	14.6	75	6/24	6/18	6/12	6/12	6/12	17.3	14.6	14.6	14.6	14.6	
52	Ochammal	388342	L	60	F	1	2 <sup>1/2</sup>	3/60	14.3	175	6/36	6/36	6/24	6/24	6/24	14.6	14.6	12.2	12.2	14.6	
53	Annamalai	439834	L	60	M	1	1	1/60	12.2	30	1/60	1/60	1/60	1/60	1/60	17.3	17.3	12.2	12.2	12.2	
54	Jaya	499830	R	50	F	1	1	3/60	17.3	66	6/18	6/18	6/12	6/12	6/12	20.8	17.3	17.3	17.3	17.3	
55	Veerammal	470302	L	75	F	1	8/12	3/60	14.6	75	6/60	6/60	6/36	6/36	6/36	17.3	14.6	14.6	14.6	14.6	Laser Markings over IOL
56	Shankaramal	410366	R	55	F	1	10/12	6/60	14.6	40	6/18	6/18	6/18	6/12	6/12	14.6	14.6	14.6	14.6	14.6	
57	Lakshmanan	480380	R	80	M	1	9/12	5/60	10.2	49	6/36	6/24	6/18	6/18	6/18	14.6	10.2	10.2	10.2	10.2	
58	Thangasami	395688	L	60	M	1	10/12	6/60	17.3	102	6/36	6/24	6/18	6/12	6/12	17.3	17.3	14.6	14.6	14.6	
59	Krishnan	474685	R	50	M	1	1	2/60	17.3	34	6/18	6/18	6/18	6/18	6/12	17.3	17.3	17.3	17.3	17.3	IOL
60	Ponnuthai	487236	L	75	F	1	1 <sup>1/2</sup>	6/60	12.2	38	6/18	6/12	6/12	6/12	6/12	14.6	14.6	12.2	12.2	12.2	
61	Vijaya	372697	R	45	F	1	1 <sup>1/4</sup>	6/36	14.6	48	6/12	6/9	6/9	6/6	6/6	14.6	14.6	14.6	14.6	14.6	Laser Markings over IOL
62	Geetha	486982	R	45	F	1	1 <sup>1/2</sup>	3/60	17.3	102	6/24	6/24	6/12	6/12	6/12	17.6	17.3	14.6	14.6	14.6	
63	Anwardeen	449827	L	60	M	1	2	3/60	12.2	10	6/36	6/9	6/9	6/9	6/6	17.3	17.3	12.2	12.2	12.2	
64	Santhanamal	482649	L	57	F	2	8/12	4/60	12.2	79	6/24	6/18	6/12	6/9	6/9	12.2	12.2	12.2	12.2	12.2	Vitreous in AC
65	Dharmar	457990	L	70	M	1	1	3/60	17.3	48	6/18	6/12	6/12	6/9	6/9	20.3	17.3	17.3	17.3	17.3	
66	Veersinnu	502671	R	50	F	1	1	4/60	12.2	69	6/18	6/12	6/12	6/12	6/9	14.6	12.6	12.6	12.2	12.2	
67	Maharaja	482609	R	70	M	1	1 <sup>1/2</sup>	5/60	17.3	58	6/12	6/9	6/9	6/9	6/9	17.3	17.3	14.6	14.6	14.6	
68	Gopal	507381	L	60	M	1	2	6/60	17.3	39	6/12	6/12	6/9	6/9	6/9	17.3	17.3	17.3	17.3	17.3	
69	Ayyathurai	475651	L	70	M	1	1	6/60	14.6	30	6/18	6/12	6/12	6/12	6/12	17.3	17.3	14.6	14.6	14.6	
70	Pangajam	449858	R	60	F	1	1 <sup>1/2</sup>	6/36	14.6	98	6/9	6/9	6/9	6/9	6/9	20.3	17.6	14.6	14.6	14.6	Iris Bleeding
71	Chandra	477652	R	45	F	1	1 <sup>1/4</sup>	2/60	14.6	79	6/24	6/24	6/18	6/18	6/18	17.3	14.6	14.6	14.6	14.6	Laser Markings over IOL
72	Kasiviswanathan	500611	L	39	M	1	1	6/24	17.3	37	6/9	6/9	6/6	6/6	6/6	17.3	14.6	14.6	14.6	14.6	
73	Saminathan	469242	L	58	M	1	2	6/60	17.3	75	6/12	6/9	6/9	6/9	6/9	17.3	17.3	14.6	14.6	14.6	
74	Annakodi	409257	L	50	F	1	10/12	6/36	12.2	45	6/9	6/6	6/6	6/6	6/6	14.6	12.8	12.8	12.8	12.8	
75	Ganga devi	379056	R	55	F	1	11/12	5/60	14.6	19	6/18	6/12	6/12	6/12	6/12	17.3	17.3	14.6	14.6	14.6	Laser Markings over IOL

76	Pandithurai	435686	R	65	M	1	1	5/60	20.3	11	6/18	6/18	6/18	6/12	6/12	20.3	17.3	17.3	17.3	17.3	
77	Saroja	465982	L	60	F	1	1 <sup>1/2</sup>	5/60	12.2	72	6/9	6/9	6/6	6/6	6/6	14.6	12.2	12.2	12.2	12.2	
78	Ramuthai	472784	R	57	F	1	1	6/60	17.3	12	6/12	6/9	6/9	6/9	6/9	20.3	17.3	17.3	17.3	17.3	
79	Karupasamy	389128	L	60	M	1	1 <sup>1/4</sup>	6/60	14.6	21	6/12	6/12	6/12	6/12	6/12	14.6	14.6	14.6	12.8	12.8	
80	Veerasingam	482890	L	55	M	2	2	6/60	17.3	46	6/12	6/9	6/9	6/9	6/9	20.3	20.3	20.3	20.3	20.3	Vitreous in AC
81	Paramaraj	499152	L	75	M	1	6/12	6/60	14.6	40	6/36	6/24	6/6	6/6	6/6	10.2	10.2	14.6	14.6	14.6	
82	Seeni thevar	457010	R	65	M	1	1	6/60	10.2	50	6/18	6/18	6/18	6/12	6/12	10.2	10.2	10.2	10.2	10.2	
83	Muthuraj	487027	L	45	M	1	1 <sup>1/2</sup>	2/60	10.2	12	6/60	6/60	6/36	6/24	6/24	14.4	10.2	10.2	10.2	10.2	Laser Markings over IOL
84	Pappu	425272	R	65	M	1	8/12	4/60	12.2	12	6/12	6/12	6/9	6/9	6/9	12.2	12.2	12.2	12.2	12.2	
85	Karuppi	505488	R	65	F	1	10/12	6/10	14.4	36	6/18	6/12	6/12	6/12	6/12	17.3	14.4	14.4	14.4	14.4	
86	Vasu	479072	L	55	M	1	9/12	6/60	17.3	40	6/18	6/12	6/12	6/12	6/12	17.3	17.3	17.3	17.3	17.3	Laser marketing over IOL
87	Banumathi	44567	L	45	F	1	10/12	3/60	17.3	48	6/36	6/36	6/12	6/6	6/6	17.3	17.3	17.3	17.3	17.3	
88	Palraj	458068	R	70	M	1	1	4/60	12.2	18	6/60	6/60	6/36	6/36	6/18	10.2	10.2	12.2	12.2	12.2	
89	Sundaram	377919	R	40	M	1	1	6/36	12.2	54	6/18	6/18	6/12	6/12	6/12	14.6	12.2	12.2	12.2	12.2	
90	Petchi	482098	L	55	F	2	8/12	6/60	17.3	40	6/36	6/18	6/18	6/18	6/18	20.3	17.3	17.3	17.3	17.3	Vitreous in AC
91	Gopalakrishnan	481240	L	65	M	1	1 <sup>1/2</sup>	5/60	17.3	96	6/12	6/9	6/9	6/9	6/9	17.3	17.3	17.3	17.3	17.3	
92	Kamatchi	489098	R	73	M	1	1 <sup>1/4</sup>	6/60	14.6	46	6/24	6/24	6/18	6/12	6/12	14.6	14.6	14.6	14.6	14.6	Laser Markings over IOL
93	Balan	508679	L	60	M	1	1	3/60	12.8	49	6/60	6/60	6/36	6/36	6/36	14.6	14.6	12.8	12.8	12.8	Flare and Cells in AC
94	Narayanan	489018	R	70	M	1	1	4/60	14.6	46	6/24	6/24	6/12	6/12	6/12	14.6	14.6	14.6	14.6	14.6	
95	Deivam	471230	L	65	M	1	8/12	5/60	17.3	48	6/18	6/18	6/12	6/12	6/12	20.3	17.3	17.3	17.3	17.3	
96	Chellathai	497814	R	60	F	1	10/12	4/60	15.6	50	6/18	6/12	6/12	6/12	6/12	15.6	15.6	15.6	15.6	15.6	
97	Kanmani	468768	L	55	F	1	1 <sup>1/2</sup>	6/60	14.4	30	6/12	6/9	6/9	6/9	6/9	14.4	14.4	14.4	14.4	14.4	IOL markings
98	Chittupillai	496889	L	70	F	1	2	2/60	10.2	56	6/36	6/36	6/24	6/24	6/24	14.4	10.2	10.2	10.2	10.2	
99	Devaki	489848	R	60	F	2	1 <sup>1/2</sup>	3/60	17.3	36	6/18	6/18	6/18	6/18	6/18	17.3	17.3	17.3	17.3	17.3	
100	Mayandi	443476	R	68	M	1	2 <sup>1/2</sup>	6/60	12.2	26	6/12	6/12	6/9	6/9	6/9	14.4	12.2	12.2	12.2	12.2	IOL markings

\*Type of surgery : 1 - Pl. ECCE with IOL 2 - Pl. ECCE